

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING



# **GOVERNMENT COLLEGE OF TECHNOLOGY**

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

**Curriculum For**

**B. E. Electronics and Instrumentation Engineering**

**(Full Time)**

# **2022**

## **Regulations**

**OFFICE OF THE CONTROLLER OF EXAMINATIONS**

**GOVERNMENT COLLEGE OF TECHNOLOGY**

**THADAGAM ROAD, COIMBATORE - 641 013.**

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# GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution affiliated to Anna University)

Coimbatore - 641 013

## **VISION AND MISSION OF THE INSTITUTION**

### ***VISION***

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind.

### ***MISSION***

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship.
- To improve the research competence to address societal needs.
- To inculcate a culture that supports and reinforces ethical, professional behaviours for a harmonious and prosperous society.



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

**GOVERNMENT COLLEGE OF TECHNOLOGY**  
**(An Autonomous Institution Affiliated to Anna University) Coimbatore–**  
**641013.**

**DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|                                             |
|---------------------------------------------|
| <b>VISION AND MISSION OF THE DEPARTMENT</b> |
|---------------------------------------------|

**VISION**

To be a premier value-based department committed to excellence in preparing students for being successful Electronics and Instrumentation Engineer with technical professions through research and Experience Based Instruction with the help of highly qualified and experienced faculty.

**MISSION**

- Educate and equip the students with strong theoretical foundations blended with practical Engineering skills through effective teaching learning methodologies.
- Provide students with employability and entrepreneurship skills through Industry-Institute Interaction.
- Encourage students to participate in societal research projects that emphasize critical thinking, teamwork and communication skills.
- Imbibe students with high professional and ethical standards through continuous learning and professional activities.

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**641013.**

**DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|                                                |
|------------------------------------------------|
| <b>PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)</b> |
|------------------------------------------------|

The following Programme Educational Objectives are designed based on the Department Mission.

**Graduates will be able to**

**PEO 1:** Excel in technical and professional jobs in sectors including Electronics, Instrumentation, Control, Automation and Information Technology.

**PEO 2:** Demonstrate competency in applying appropriate modern engineering tools to solve technical problems and contribute to the society in a professional manner.

**PEO 3:** Work effectively as an individual and a team in multidisciplinary projects.

**PEO 4:** Include entrepreneurial to spirit through effective communication and leadership skills.

**PEO 5:** Contribute to new technological breakthroughs in emerging fields of engineering by engaging in life-long learning.



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**DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|                                 |
|---------------------------------|
| <b>PROGRAMME OUTCOMES (POs)</b> |
|---------------------------------|

- **PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
  - **PO2: Problem analysis:** Identify, formulate, review research literature and analyze complex Engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
  - **PO3: Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.
  - **PO4: Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.
  - **PO5: Modern tool usage:** Create, select and apply appropriate techniques, resources and modern Engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
  - **PO6: The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
  - **PO7: Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
  - **PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
  - **PO9: Individual and team work:** Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.
  - **PO10: Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.
  - **PO11: Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
  - **PO12: Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
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**DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|                                           |
|-------------------------------------------|
| <b>PROGRAMME SPECIFIC OUTCOMES (PSOs)</b> |
|-------------------------------------------|

After completion of the Electronics and Instrumentation Engineering programme, students will be able to

**PSO1:** Observe, analyze, test and design analog and digital electronic circuits for real-time applications.

**PSO2:** Select, design, commission, calibrate and maintain a range of instruments for effective control

and safe operation of various industrial processes.

**PSO3:** Design and build instrumentation systems using latest technologies with modern hardware and software tools / programs for advanced industrial automation applications.



**GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE-641013.**  
**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING (FULLTIME)**

**FIRST SEMESTER**

| Sl. No    | Course Code | Course Title                          | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |    |    |      |
|-----------|-------------|---------------------------------------|----------|----------|---------------|-------------|------------|----|----|------|
|           |             |                                       |          |          |               |             | L          | T  | P  | C    |
| THEORY    |             |                                       |          |          |               |             |            |    |    |      |
|           | 22NMC1Z0    | Induction Programme                   | MC       | --       | --            | --          | --         | -- | -- | 0    |
| 1         | 22NHS1Z1    | தமிழ் மரபு<br>Heritage of Tamils      | HSMC     | 40       | 60            | 100         | 1          | 0  | 0  | 1    |
| 2         | 22NHS1Z2    | Professional English                  | HSMC     | 40       | 60            | 100         | 2          | 1  | 0  | 3    |
| 3         | 22NBS1Z1    | Linear Algebra and Calculus           | BS       | 40       | 60            | 100         | 3          | 1  | 0  | 4    |
| 4         | 22NBS1Z2    | Engineering Physics                   | BS       | 40       | 60            | 100         | 3          | 0  | 0  | 3    |
| 5         | 22NES101    | Programming in C                      | ES       | 40       | 60            | 100         | 3          | 0  | 0  | 3    |
| 6         | 22NMC1Z1    | Environmental Science and Engineering | MC       | 40       | 60            | 100         | 3          | 0  | 0  | 0    |
| PRACTICAL |             |                                       |          |          |               |             |            |    |    |      |
| 7         | 22NHS1Z3    | Cambridge English                     | HSMC     | 100      | --            | 100         | 0          | 0  | 2  | 1    |
| 8         | 22NBS1Z3    | Physics Laboratory                    | BS       | 60       | 40            | 100         | 0          | 0  | 3  | 1.5  |
| 9         | 22NES1Z2    | Workshop Practice                     | ES       | 60       | 40            | 100         | 0          | 0  | 3  | 1.5  |
| 10        | 22NES103    | Programming in C Laboratory           | ES       | 60       | 40            | 100         | 0          | 0  | 3  | 1.5  |
| TOTAL     |             |                                       |          | 520      | 480           | 1000        | 15         | 2  | 11 | 19.5 |

| Sl. No    | Course Code | Course Title                                       | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |      |
|-----------|-------------|----------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|------|
|           |             |                                                    |          |          |               |             | L          | T | P | C    |
| THEORY    |             |                                                    |          |          |               |             |            |   |   |      |
| 1         | 22NHS2Z4    | தமிழரும் தொழில் நுட்பமும்<br>Tamils and Technology | HSMC     | 40       | 60            | 100         | 1          | 0 | 0 | 1    |
| 2         | 22NHS2Z5    | Values and Ethics                                  | HSMC     | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 3         | 22NBS204    | Differential Equations and Numerical Methods       | BS       | 40       | 60            | 100         | 3          | 1 | 0 | 4    |
| 4         | 22NBS205    | Physics of Materials                               | BS       | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 5         | 22NBS206    | Applied Chemistry                                  | BS       | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 6         | 22NES204    | Basics of Civil and Mechanical Engineering         | ES       | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
|           | 22NNC201    | NCC Credit Course Level - I (optional)             |          | 100      | --            | 100         | 3          | 0 | 0 | 3    |
| PRACTICAL |             |                                                    |          |          |               |             |            |   |   |      |
| 7         | 22NBS2Z7    | Chemistry Laboratory                               | BS       | 60       | 40            | 100         | 0          | 0 | 3 | 1.5  |
| 8         | 22NES2Z5    | Engineering Graphics                               | ES       | 60       | 40            | 100         | 1          | 0 | 4 | 3    |
| TOTAL     |             |                                                    |          | 360      | 440           | 800         | 17         | 1 | 7 | 21.5 |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

**THIRD SEMESTER**

| Sl. No    | Course Code | Course Title                                            | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |      |
|-----------|-------------|---------------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|------|
|           |             |                                                         |          |          |               |             | L          | T | P | C    |
| THEORY    |             |                                                         |          |          |               |             |            |   |   |      |
| 1         | 22NES306    | Thermodynamics and Fluid Mechanics                      | ES       | 40       | 60            | 100         | 4          | 0 | 0 | 4    |
| 2         | 22NPC301    | Electrical Circuits and Networks                        | PC       | 40       | 60            | 100         | 3          | 1 | 0 | 4    |
| 3         | 22NPC302    | Analog Electronics                                      | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 4         | 22NPC303    | Sensors and Transducers                                 | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 5         | 22NPC304    | Electrical and Electronic Measurement Techniques        | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 6         | 22NMC3Z2    | Constitution of India (Common to All Branches)          | MC       | 40       | 60            | 100         | 3          | 0 | 0 | 0    |
| PRACTICAL |             |                                                         |          |          |               |             |            |   |   |      |
| 7         | 22NES307    | Engineering Exploration for Instrumentation Engineering | ES       | 100      | --            | 100         | 0          | 0 | 3 | 1.5  |
| 8         | 22NPC305    | Sensors and Measurements Laboratory                     | PC       | 60       | 40            | 100         | 0          | 0 | 3 | 1.5  |
| 9         | 22NPC306    | Electrical and Electronic Circuits Laboratory           | PC       | 60       | 40            | 100         | 0          | 0 | 3 | 1.5  |
| TOTAL     |             |                                                         |          | 460      | 440           | 900         | 19         | 1 | 9 | 21.5 |

**FOURTH SEMES**

| Sl. No    | Course Code | Course Title                                                         | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |     |
|-----------|-------------|----------------------------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|-----|
|           |             |                                                                      |          |          |               |             | L          | T | P | C   |
| THEORY    |             |                                                                      |          |          |               |             |            |   |   |     |
| 1         | 22NBS408    | Fourier Series and Transform Calculus (Common to EEE & EIE Branches) | BS       | 40       | 60            | 100         | 3          | 1 | 0 | 4   |
| 2         | 22NES408    | Electrical Machines                                                  | ES       | 40       | 60            | 100         | 3          | 0 | 0 | 3   |
| 3         | 22NPC407    | Electronics for Analog Signal Processing                             | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3   |
| 4         | 22NPC408    | Digital Electronics                                                  | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3   |
| 5         | 22NPC409    | Industrial Instrumentation                                           | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3   |
| 6         | 22NPC410    | Fundamentals of Signals and Systems                                  | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3   |
| PRACTICAL |             |                                                                      |          |          |               |             |            |   |   |     |
| 7         | 22NPC411    | Analog and Digital Circuits Laboratory                               | PC       | 60       | 40            | 100         | 0          | 0 | 3 | 1.5 |
| 8         | 22NPC412    | Virtual Instrumentation Laboratory                                   | PC       | 60       | 40            | 100         | 0          | 0 | 3 | 1.5 |
| Total     |             |                                                                      |          | 360      | 440           | 800         | 18         | 1 | 6 | 22  |

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 B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING  
**FIFTH SEMESTER**

| Sl. No    | Course Code | Course Title                                                 | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |     |
|-----------|-------------|--------------------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|-----|
|           |             |                                                              |          |          |               |             | L          | T | P | C   |
| THEORY    |             |                                                              |          |          |               |             |            |   |   |     |
| 1         | 22NPC513    | Control System Design                                        | PC       | 40       | 60            | 100         | 3          | 1 | 0 | 4   |
| 2         | 22NPC514    | Fundamentals of Digital Signal Processing                    | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3   |
| 3         | 22NPC515    | Microprocessors, Microcontrollers and Interfacing            | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3   |
| 4         | 22NPC516    | Principles of Communication Systems                          | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3   |
| 5         | 22NPC517    | Industrial Hydraulics and Pneumatics                         | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3   |
| 6         | 22NPE\$XX   | Professional Elective - I                                    | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3   |
| PRACTICAL |             |                                                              |          |          |               |             |            |   |   |     |
| 7         | 22NPC518    | Control System Design Laboratory                             | PC       | 60       | 40            | 100         | 0          | 0 | 3 | 1.5 |
| 8         | 22NPC519    | Microprocessors, Microcontrollers and Interfacing Laboratory | PC       | 60       | 40            | 100         | 0          | 0 | 3 | 1.5 |
| 9         | 22NPC520    | Industrial Instrumentation Laboratory                        | PC       | 60       | 40            | 100         | 0          | 0 | 2 | 1   |
| TOTAL     |             |                                                              |          | 420      | 480           | 900         | 18         | 1 | 8 | 23  |

**SIXTH SEMESTER**

| Sl. No    | Course Code | Course Title                                                            | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |      |
|-----------|-------------|-------------------------------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|------|
|           |             |                                                                         |          |          |               |             | L          | T | P | C    |
| THEORY    |             |                                                                         |          |          |               |             |            |   |   |      |
| 1         | 22NHS606    | Industrial Management and Economics( <i>Common to EIE, CSE and IT</i> ) | HSMC     | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 2         | 22NPC621    | Process Dynamics and Control                                            | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 3         | 22NPC622    | Industrial Control Systems                                              | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 4         | 22NPC623    | Basics of VLSI design                                                   | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 5         | 22NPE\$XX   | Professional Elective - II                                              | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| 6         | 22#OE\$XX   | Open Elective– I/Professional Elective– VII                             | PE/OE    | 40       | 60            | 100         | 3          | 0 | 0 | 3    |
| PRACTICAL |             |                                                                         |          |          |               |             |            |   |   |      |
| 7         | 22NPC624    | Process Control Laboratory                                              | PC       | 60       | 40            | 100         | 0          | 0 | 3 | 1.5  |
| 8         | 22NPC625    | Industrial Control Systems Laboratory                                   | PC       | 60       | 40            | 100         | 0          | 0 | 3 | 1.5  |
| 9         | 22NES609    | Design Thinking for Instrumentation Engineering                         | ES       | 100      | --            | 100         | 0          | 0 | 3 | 1.5  |
| TOTAL     |             |                                                                         |          | 460      | 440           | 900         | 18         | 0 | 9 | 22.5 |

## SEVENTHSEMESTER

| Sl. No              | Course Code | Course Title                                      | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |    |
|---------------------|-------------|---------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|----|
|                     |             |                                                   |          |          |               |             | L          | T | P | C  |
| THEORY              |             |                                                   |          |          |               |             |            |   |   |    |
| 1                   | 22NES710    | Fundamentals of Soft Computing                    | ES       | 40       | 60            | 100         | 3          | 0 | 0 | 3  |
| 2                   | 22NPC726    | Power Electronic Devices and Circuits             | PC       | 40       | 60            | 100         | 3          | 0 | 0 | 3  |
| 3                   | 22NPE\$XX   | Professional Elective – III                       | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3  |
| 4                   | 22NPE\$XX   | Professional Elective–IV                          | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3  |
| 5                   | 22#OE\$XX   | Open Elective – II/<br>Professional Elective–VIII | PE/OE    | 40       | 60            | 100         | 3          | 0 | 0 | 3  |
| THEORYWITHPRACTICAL |             |                                                   |          |          |               |             |            |   |   |    |
| 6                   | 22NPC727    | Instrumentation System Design                     | PC       | 50       | 50            | 100         | 2          | 0 | 4 | 4  |
| PRACTICAL           |             |                                                   |          |          |               |             |            |   |   |    |
| 7                   | 22NEE701    | Engineering Projects in Community Service         | EEC      | 60       | 40            | 100         | 0          | 0 | 4 | 2  |
| 8                   | 22NEE702    | Internship *                                      | EEC      | 100      | 0             | 100         | 0          | 0 | 0 | 4  |
| TOTAL               |             |                                                   |          | 410      | 390           | 800         | 17         | 0 | 8 | 25 |

## EIGHTHSEMESTER

| Sl. No    | Course Code | Course Title             | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |    |    |
|-----------|-------------|--------------------------|----------|----------|---------------|-------------|------------|---|----|----|
|           |             |                          |          |          |               |             | L          | T | P  | C  |
| THEORY    |             |                          |          |          |               |             |            |   |    |    |
| 1         | 22NPE\$XX   | Professional Elective–V  | PE       | 40       | 60            | 100         | 3          | 0 | 0  | 3  |
| 2         | 22NPE\$XX   | Professional Elective–VI | PE       | 40       | 60            | 100         | 3          | 0 | 0  | 3  |
| PRACTICAL |             |                          |          |          |               |             |            |   |    |    |
| 3         | 22NEE803    | Capstone Project         | EEC      | 60       | 40            | 100         | 0          | 0 | 16 | 8  |
| TOTAL     |             |                          |          | 140      | 160           | 300         | 6          | 0 | 16 | 14 |

**Note:**

\* Internship of four consecutive weeks or two 2 consecutive weeks which are completed During the vacation of fourth (and/or) fifth (and/or) sixth semester shall be considered here.

Total credits=165+4 = 169

**SUMMARY OF CREDIT DISTRIBUTION**

| S.No         | Course Category | Credits per Semester |             |             |           |           |             |           |           | Total number of credits | Total credits in % | Credits as Per AICTE Model Curriculum |
|--------------|-----------------|----------------------|-------------|-------------|-----------|-----------|-------------|-----------|-----------|-------------------------|--------------------|---------------------------------------|
|              |                 | I                    | II          | III         | IV        | V         | VI          | VII       | VIII      |                         |                    |                                       |
| 1            | HS/HSMC         | 5                    | 4           | -           | -         | -         | 3           | -         | -         | 12                      | 7.10               | 12                                    |
| 2            | BS              | 8.5                  | 11.5        | -           | 4         | -         | -           | -         | -         | 24                      | 14.20              | 25                                    |
| 3            | ES              | 6                    | 6           | 5.5         | 3         | -         | 1.5         | 3         | -         | 25                      | 14.79              | 24                                    |
| 4            | PC              | -                    | -           | 16          | 15        | 20        | 12          | 7         | -         | 70                      | 41.42              | 48                                    |
| 5            | PE              | -                    | -           | -           | -         | 3         | 3           | 6         | 6         | 18                      | 10.65              | 18                                    |
| 6            | OE              | -                    | -           | -           | -         | -         | 3           | 3         | -         | 6                       | 3.55               | 18                                    |
| 7            | EEC             | -                    | -           | -           | -         | -         | -           | 6         | 8         | 14                      | 8.28               | 15                                    |
| 8            | MC              | 0                    | 0           | 0           | -         | -         | -           | -         | -         | 0                       | 0                  | 0                                     |
| <b>TOTAL</b> |                 | <b>19.5</b>          | <b>21.5</b> | <b>21.5</b> | <b>22</b> | <b>23</b> | <b>22.5</b> | <b>25</b> | <b>14</b> | <b>169</b>              | <b>100</b>         | <b>160</b>                            |

Total credits=169

**CATEGORY WISE CREDIT DISTRIBUTION**  
**HUMANITIES AND SOCIAL SCIENCE INCLUDING MANAGEMENT (HS/HSMC)**

| Sl. No | Course Code | Course Title                                          | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |   |
|--------|-------------|-------------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|---|
|        |             |                                                       |          |          |               |             | L          | T | P | C |
| 1      | 22NHS1Z1    | தமிழ் மரபு<br>Heritage of Tamils                      | BS       | 40       | 60            | 100         | 3          | 1 | 0 | 4 |
| 2      | 22NHS1Z2    | Professional English                                  | BS       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 3      | 22NHS1Z3    | Cambridge English                                     | HSMC     | 100      | --            | 100         | 0          | 0 | 2 | 1 |
| 4      | 22NHS2Z4    | தமிழரும் தொழில்<br>நுட்பமும்<br>Tamils and Technology | HSMC     | 40       | 60            | 100         | 1          | 0 | 0 | 1 |
| 5      | 22NHS2Z5    | Values and Ethics                                     | HSMC     | 40       | 60            | 100         | 3          | 0 | 0 | 3 |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING  
BASIC SCIENCE (BS)**

| Sl. No       | Course Code | Course Title                                 | Category | CA Marks   | End Sem Marks | Total Marks | Hours/Week |          |          |           |
|--------------|-------------|----------------------------------------------|----------|------------|---------------|-------------|------------|----------|----------|-----------|
|              |             |                                              |          |            |               |             | L          | T        | P        | C         |
| 1            | 22NBS1Z1    | Linear Algebra and Calculus                  | BS       | 40         | 60            | 100         | 3          | 1        | 0        | 4         |
| 2            | 22NBS1Z2    | Engineering Physics                          | BS       | 40         | 60            | 100         | 3          | 0        | 0        | 3         |
| 3            | 22NBS1Z3    | Physics Laboratory                           | BS       | 40         | 60            | 100         | 0          | 0        | 3        | 1.5       |
| 4            | 22NBS204    | Differential Equations and Numerical Methods | BS       | 40         | 60            | 100         | 3          | 1        | 0        | 4         |
| 5            | 22NBS205    | Physics of Materials                         | BS       | 40         | 60            | 100         | 3          | 0        | 0        | 3         |
| 6            | 22NBS206    | Applied Chemistry                            | BS       | 40         | 60            | 100         | 3          | 0        | 0        | 3         |
| 7            | 22NBS2Z7    | Chemistry Laboratory                         | BS       | 40         | 60            | 100         | 0          | 0        | 3        | 1.5       |
| 8            | 22NBS408    | Fourier Series and Transform Calculus        | BS       | 40         | 60            | 100         | 3          | 1        | 0        | 4         |
| <b>TOTAL</b> |             |                                              |          | <b>320</b> | <b>480</b>    | <b>800</b>  | <b>18</b>  | <b>3</b> | <b>6</b> | <b>24</b> |

**ENGINEERING SCIENCE (ES)**

| Sl. No       | Course Code | Course Title                                            | Category | CA Marks   | End Sem Marks | Total Marks | Hours/Week |          |           |           |
|--------------|-------------|---------------------------------------------------------|----------|------------|---------------|-------------|------------|----------|-----------|-----------|
|              |             |                                                         |          |            |               |             | L          | T        | P         | C         |
| 1            | 22NES101    | Programming in C                                        | ES       | 40         | 60            | 100         | 3          | 0        | 0         | 3         |
| 2            | 22NES1Z2    | Workshop Practice                                       | ES       | 40         | 60            | 100         | 0          | 0        | 3         | 1.5       |
| 3            | 22NES103    | Programming in C Laboratory                             | ES       | 40         | 60            | 100         | 0          | 0        | 3         | 1.5       |
| 4            | 22NES204    | Basics of Civil and Mechanical Engineering              | ES       | 40         | 60            | 100         | 3          | 0        | 0         | 3         |
| 5            | 22NES2Z5    | Engineering Graphics                                    | ES       | 40         | 60            | 100         | 1          | 0        | 4         | 3         |
| 6            | 22NES306    | Thermodynamics and Fluid Mechanics                      | ES       | 40         | 60            | 100         | 4          | 0        | 0         | 4         |
| 7            | 22NES307    | Engineering Exploration for Instrumentation Engineering | ES       | 100        | --            | 100         | 0          | 0        | 3         | 1.5       |
| 8            | 22NES307    | Electrical Machines                                     | ES       | 40         | 60            | 100         | 3          | 0        | 0         | 3         |
| 9            | 22NES609    | Design Thinking for Instrumentation Engineering         | ES       | 100        | --            | 100         | 0          | 0        | 3         | 1.5       |
| 10           | 22NES710    | Fundamentals of Soft Computing                          | ES       | 40         | 60            | 100         | 3          | 0        | 0         | 3         |
| <b>TOTAL</b> |             |                                                         |          | <b>520</b> | <b>480</b>    | <b>1000</b> | <b>17</b>  | <b>0</b> | <b>16</b> | <b>25</b> |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING  
PROFESSIONAL CORE (PC)**

| Sl. No       | Course Code | Course Title                                                 | Category | CA Marks    | End Sem Marks | Total Marks | Hours/Week |          |           |           |
|--------------|-------------|--------------------------------------------------------------|----------|-------------|---------------|-------------|------------|----------|-----------|-----------|
|              |             |                                                              |          |             |               |             | L          | T        | P         | C         |
| 1            | 22NPC301    | Electrical Circuits and Networks                             | PC       | 40          | 60            | 100         | 3          | 1        | 0         | 4         |
| 2            | 22NPC302    | Analog Electronics                                           | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 3            | 22NPC303    | Sensors and Transducers                                      | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 4            | 22NPC304    | Measurements and Instrumentation                             | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 5            | 22NPC305    | Sensors and Measurements Laboratory                          | PC       | 40          | 60            | 100         | 0          | 0        | 3         | 1.5       |
| 6            | 22NPC306    | Electrical and Electronic Circuits Laboratory                | PC       | 40          | 60            | 100         | 0          | 0        | 3         | 1.5       |
| 7            | 22NPC407    | Electronics for Analog Signal Processing                     | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 8            | 22NPC408    | Digital Electronics                                          | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 9            | 22NPC409    | Industrial Instrumentation                                   | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 10           | 22NPC410    | Fundamentals of Signals and Systems                          | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 11           | 22NPC411    | Analog and Digital Circuits Laboratory                       | PC       | 40          | 60            | 100         | 0          | 0        | 3         | 1.5       |
| 12           | 22NPC412    | Virtual Instrumentation Laboratory                           | PC       | 40          | 60            | 100         | 0          | 0        | 3         | 1.5       |
| 13           | 22NPC513    | Control System Design                                        | PC       | 40          | 60            | 100         | 3          | 1        | 0         | 4         |
| 14           | 22NPC514    | Fundamentals of Digital Signal Processing                    | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 15           | 22NPC515    | Microprocessors, Microcontrollers and Interfacing            | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 16           | 22NPC516    | Principles of Communication Systems                          | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 17           | 22NPC517    | Industrial Hydraulics and Pneumatics                         | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 18           | 22NPC518    | Control System Design Laboratory                             | PC       | 40          | 60            | 100         | 0          | 0        | 3         | 1.5       |
| 19           | 22NPC519    | Microprocessors, Microcontrollers and Interfacing laboratory | PC       | 40          | 60            | 100         | 0          | 0        | 3         | 1.5       |
| 20           | 22NPC520    | Industrial Instrumentation Laboratory                        | PC       | 40          | 60            | 100         | 0          | 0        | 2         | 1         |
| 21           | 22NPC621    | Process Dynamics and Control                                 | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 22           | 22NPC622    | Industrial Control systems                                   | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 23           | 22NPC623    | Basics of VLSI Design                                        | PC       | 40          | 60            | 100         | 0          | 0        | 3         | 1.5       |
| 24           | 22NPC624    | Process Control and Instrumentation Laboratory               | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 25           | 22NPC625    | Industrial Control systems Laboratory                        | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 26           | 22NPC726    | Power electronic devices and circuits                        | PC       | 40          | 60            | 100         | 3          | 0        | 0         | 3         |
| 27           | 22NPC727    | Instrumentation System Design                                | PC       | 50          | 50            | 100         | 2          | 0        | 4         | 4         |
| <b>TOTAL</b> |             |                                                              |          | <b>1080</b> | <b>1620</b>   | <b>2700</b> | <b>56</b>  | <b>2</b> | <b>27</b> | <b>70</b> |

## PROFESSIONAL ELECTIVE COURSES : VERTICALS

| S.No | Vertical I                                          | Vertical II                                                            | Vertical III                                     | Vertical IV                                                      | Vertical V                                                     | Vertical VI                                                                           |
|------|-----------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------------------------------------|
|      | Advanced Control                                    | Applied Instrumentation                                                | Health Care Instrumentation                      | Industrial Automation                                            | Instrumentation and Control (Minors)                           | Diversified Group I #                                                                 |
| 1    | 22NPE\$01 Advanced Control Theory                   | 22NPE\$09 Fiber Optics and Laser Instrumentation                       | 22NPE\$17 Biomedical Instrumentation             | 22NPE\$25 Unit operations                                        | 22NPE\$33 Transducer Engineering                               | 22NPE\$39 Analytical Instrumentation                                                  |
| 2    | 22NPE\$02 Process Modeling and Simulation           | 22NPE\$10 Thermal Power Plant Instrumentation<br>(Common to EEE & EIE) | 22NPE\$18 Bio Signal Processing                  | 22NPE\$26 Intelligent Automation                                 | 22NPE\$34 Principles of Electrical and Electronic Measurements | 22NPE\$40 Real Time Embedded Systems                                                  |
| 3    | 22NPE\$03 Computer Control of Processes             | 22NPE\$11 Instrumentation and Control in Petro Chemical Industries     | 22NPE\$19 Principles of Digital Image Processing | 22NPE\$27 Robotics and its Applications                          | 22NPE\$35 Field Instrumentation                                | 22NPE\$41 Electronic Circuit Design *<br>(Common to EEE, ECE & EIE)                   |
| 4    | 22NPE\$04 System Identification                     | 22NPE\$12 Aircraft Instrumentation                                     | 22NPE\$20 Medical Imaging                        | 22NPE\$28 Industrial Internet of Things<br>(Common to ECE & EIE) | 22NPE\$36 Process Control                                      | 22NPE\$42 Electronic System Design and Productization *<br>(Common to EEE, ECE & EIE) |
| 5    | 22NPE\$05 Non Linear Control                        | 22NPE\$13 Automotive Instrumentation                                   | 22NPE\$21 Medical Image Processing               | 22NPE\$29 Data Analytics for IoT                                 | 22NPE\$37 Industrial Automation Systems                        | 22NPE\$43 Principles of CMOS VLSI Design                                              |
| 6    | 22NPE\$06 Adaptive Control<br>(Common to EEE & EIE) | 22NPE\$14 Safety Instrumented Systems                                  | 22NPE\$22 Medical Robotics                       | 22NPE\$30 IoT for Smart Cities                                   | 22NPE\$38 Virtual Instrumentation (Theory with Practical)      | 22NPE\$44 Industrial Data Networks                                                    |
| 7    | 22NPE\$07 Model Based Control                       | 22NPE\$15 Smart and Wireless Instrumentation                           | 22NPE\$23 Diagnostic and Therapeutic Equipment   | 22NPE\$31 Building Automation                                    | 22NPE\$09 Fibre Optics and Laser Instrumentation               | 22NPE\$45 MEMS and Nano Technology                                                    |
| 8    | 22NPE\$08 Machine Monitoring System                 | 22NPE\$16 Electric Vehicles                                            | 22NPE\$24 Physiological Control Systems          | 22NPE\$32 Smart Farming                                          | 22NPE\$17 Biomedical Instrumentation                           | 22NPE\$46 Concepts of Machine Learning                                                |

\* Industry offered electives

# This vertical will not be offered for B.E Minor degree

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING  
VERTICAL – I**

**ADVANCED CONTROL**

| Sl. No | Course Code | Course Title                              | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |   |
|--------|-------------|-------------------------------------------|----------|----------|---------------|-------------|------------|---|---|---|
|        |             |                                           |          |          |               |             | L          | T | P | C |
| 1      | 22NPE\$01   | Advanced Control Theory                   | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 2      | 22NPE\$02   | Process Modeling and Simulation           | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 3      | 22NPE\$03   | Computer Control of Processes             | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 4      | 22NPE\$04   | System Identification                     | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 5      | 22NPE\$05   | Non Linear Control                        | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 6      | 22NPE\$06   | Adaptive Control<br>(Common to EEE & EIE) | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 7      | 22NPE\$07   | Model Based Control                       | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 8      | 22NPE\$08   | Machine Monitoring System                 | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |

**VERTICAL – II**

**APPLIED INSTRUMENTATION**

| Sl. No | Course Code | Course Title                                                 | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |   |
|--------|-------------|--------------------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|---|
|        |             |                                                              |          |          |               |             | L          | T | P | C |
| 1      | 22NPE\$09   | Fiber Optics and Laser Instrumentation                       | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 2      | 22NPE\$10   | Thermal Power Plant Instrumentation<br>(Common to EEE & EIE) | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 3      | 22NPE\$11   | Instrumentation and Control in Petro Chemical Industries     | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 4      | 22NPE\$12   | Aircraft Instrumentation                                     | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 5      | 22NPE\$13   | Automotive Instrumentation                                   | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 6      | 22NPE\$14   | Safety Instrumented Systems                                  | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 7      | 22NPE\$15   | Smart and Wireless Instrumentation                           | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 8      | 22NPE\$16   | Electric Vehicles                                            | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING  
VERTICAL – III**

**HEALTH CARE INSTRUMENTATION**

| Sl. No | Course Code | Course Title                           | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |   |
|--------|-------------|----------------------------------------|----------|----------|---------------|-------------|------------|---|---|---|
|        |             |                                        |          |          |               |             | L          | T | P | C |
| 1      | 22NPE\$17   | Biomedical Instrumentation             | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 2      | 22NPE\$18   | Bio Signal Processing                  | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 3      | 22NPE\$19   | Principles of Digital Image Processing | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 4      | 22NPE\$20   | Medical Imaging                        | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 5      | 22NPE\$21   | Medical Image Processing               | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 6      | 22NPE\$22   | Medical Robotics                       | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 7      | 22NPE\$23   | Diagnostic and Therapeutic Equipment   | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 8      | 22NPE\$24   | Physiological Control Systems          | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |

**VERTICAL – IV**

**INDUSTRIAL AUTOMATION**

| Sl. No | Course Code | Course Title                                           | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |   |
|--------|-------------|--------------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|---|
|        |             |                                                        |          |          |               |             | L          | T | P | C |
| 1      | 22NPE\$25   | Unit Operations                                        | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 2      | 22NPE\$26   | Intelligent Automation                                 | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 3      | 22NPE\$27   | Robotics and its Applications                          | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 4      | 22NPE\$28   | Industrial Internet of Things<br>(Common to ECE & EIE) | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 5      | 22NPE\$29   | Data Analytics for IoT                                 | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 6      | 22NPE\$30   | IoT for Smart Cities                                   | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 7      | 22NPE\$31   | Building Automation                                    | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 8      | 22NPE\$32   | Smart Farming                                          | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING  
VERTICAL – V**

**INSTRUMENTATION AND CONTROL**

| Sl. No | Course Code | Course Title                                         | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |   |
|--------|-------------|------------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|---|
|        |             |                                                      |          |          |               |             | L          | T | P | C |
| 1      | 22NPE\$33   | Transducer Engineering                               | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 2      | 22NPE\$34   | Principles of Electrical and Electronic Measurements | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 3      | 22NPE\$35   | Field Instrumentation                                | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 4      | 22NPE\$36   | Process Control                                      | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 5      | 22NPE\$37   | Industrial Automation Systems                        | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 6      | 22NPE\$38   | Virtual Instrumentation (Theory with Practical)      | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 7      | 22NPE\$09   | Fibre Optics and Laser Instrumentation               | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 8      | 22NPE\$17   | Biomedical Instrumentation                           | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |

**VERTICAL – VI**

**DIVERSIFIED GROUP I**

| Sl. No | Course Code | Course Title                                                                | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |   |
|--------|-------------|-----------------------------------------------------------------------------|----------|----------|---------------|-------------|------------|---|---|---|
|        |             |                                                                             |          |          |               |             | L          | T | P | C |
| 1      | 22NPE\$39   | Analytical Instrumentation                                                  | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 2      | 22NPE\$40   | Real Time Embedded Systems                                                  | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 3      | 22NPE\$41   | Electronic Circuit Design *<br>(Common to EEE, ECE & EIE)                   | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 4      | 22NPE\$42   | Electronic System Design and Productization *<br>(Common to EEE, ECE & EIE) | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 5      | 22NPE\$43   | Principles of CMOS VLSI Design                                              | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 6      | 22NPE\$44   | Industrial Data Networks                                                    | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 7      | 22NPE\$45   | MEMS and Nano Technology                                                    | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 8      | 22NPE\$46   | Concepts of Machine Learning                                                | PE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |

\* Industry offered electives

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

**OPEN ELECTIVE (OE)**

| Sl. No | Course Code | Course Title                           | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |   |
|--------|-------------|----------------------------------------|----------|----------|---------------|-------------|------------|---|---|---|
|        |             |                                        |          |          |               |             | L          | T | P | C |
| 1.     | 22COE\$01   | Disaster Management and Mitigation     | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 2.     | 22COE\$02   | Water Sanitation and Health            | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 3.     | 22MOE\$03   | Nanotechnology and Surface Engineering | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 4.     | 22MOE\$04   | Industrial Safety Management           | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 5.     | 22EOE\$05   | Renewable Power Generation Systems     | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 6.     | 22EOE\$06   | Smart Grid Technology                  | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 7.     | 22LOE\$07   | CMOS VLSI Design                       | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 8.     | 22LOE\$08   | Mobile Communication                   | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 9.     | 22POE\$09   | Rapid Prototyping                      | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 10.    | 22POE\$10   | Managerial Economics                   | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 11.    | 22NOE\$11   | Measurement and Control                | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 12.    | 22NOE\$12   | Industrial Automation                  | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 13.    | 22SOE\$13   | Programming in Java                    | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 14.    | 22SOE\$14   | Network Essential                      | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 15.    | 22IOE\$15   | Video creation and editing             | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 16.    | 22IOE\$16   | Digital marketing                      | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 17.    | 22BOE\$17   | Principles Of Food Technology          | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |
| 18.    | 22BOE\$18   | Biology For Engineers                  | OE       | 40       | 60            | 100         | 3          | 0 | 0 | 3 |

**B.E.ELECTRONICSANDINSTRUMENTATIONENGINEERING**  
**EMPLOYABILITY ENHANCEMENT COURSE (EEC)**

| Sl. No       | Course Code | Course Title                              | Category | CA Marks   | End Sem Marks | Total Marks | Hours/Week |          |           |           |
|--------------|-------------|-------------------------------------------|----------|------------|---------------|-------------|------------|----------|-----------|-----------|
|              |             |                                           |          |            |               |             | L          | T        | P         | C         |
| 1            | 22NEE701    | Engineering Projects in Community Service | EEC      | 60         | 40            | 100         | 0          | 0        | 4         | 2         |
| 2            | 22NEE702    | Internship                                | EEC      | 100        | 0             | 100         | 0          | 0        | 0         | 4         |
| 3            | 22NEE803    | Capstone Project                          | EEC      | 60         | 40            | 100         | 0          | 0        | 16        | 8         |
| <b>TOTAL</b> |             |                                           |          | <b>220</b> | <b>80</b>     | <b>300</b>  | <b>0</b>   | <b>0</b> | <b>20</b> | <b>14</b> |

**MANDATORY COURSE (MC)–(NOCREDIT)**

| Sl. No       | Course Code | Course Title                           | Category | CA Marks  | End Sem Marks | Total Marks | Hours/Week |          |          |          |
|--------------|-------------|----------------------------------------|----------|-----------|---------------|-------------|------------|----------|----------|----------|
|              |             |                                        |          |           |               |             | L          | T        | P        | C        |
| 1            | 22NMC1Z0    | Induction Programme                    | MC       | -         | -             | -           | -          | -        | -        | 0        |
| 2            | 22NMC1Z1    | Environmental Sciences and Engineering | MC       | 40        | 60            | 100         | 3          | 0        | 0        | 0        |
| 3            | 22NMC3Z2    | Constitution of India                  | MC       | 40        | 60            | 100         | 3          | 0        | 0        | 0        |
| <b>TOTAL</b> |             |                                        |          | <b>80</b> | <b>120</b>    | <b>200</b>  | <b>6</b>   | <b>0</b> | <b>0</b> | <b>0</b> |

**VALUEADDEDCOURSE**

| Sl. No | Course Code | Course Title                             | Category | CA Marks | End Sem Marks | Total Marks | Hours/Week |   |   |   |
|--------|-------------|------------------------------------------|----------|----------|---------------|-------------|------------|---|---|---|
|        |             |                                          |          |          |               |             | L          | T | P | C |
| 1      |             | NPTEL/SWAYAM Courses                     | EEC      | 100      | 0             | 100         | 1          | 0 | 0 | 1 |
| 2      |             | Coursera Courses                         | EEC      | 100      | 0             | 100         | 1          | 0 | 0 | 1 |
| 3      |             | Edx Courses                              | EEC      | 100      | 0             | 100         | 1          | 0 | 0 | 1 |
| 3      |             | Research Publication                     | EEC      | 100      | 0             | 100         | 1          | 0 | 0 | 1 |
|        | 22NVA\$01   | Microsoft Office Essentials              | EEC      | 100      | 0             | 100         | 2          | 0 | 0 | 2 |
| 4      | 22NVA\$02   | Circuit Design and Simulation            | EEC      | 100      | 0             | 100         | 1          | 0 | 0 | 1 |
| 5      | 22NVA\$03   | PCB Design and Fabrication               | EEC      | 100      | 0             | 100         | 1          | 0 | 0 | 1 |
| 6      | 22NVA\$04   | Graphic Communication                    | EEC      | 100      | 0             | 100         | 1          | 0 | 0 | 1 |
| 7      | 22NVA\$05   | Integrated Development Environment       | EEC      | 100      | 0             | 100         | 1          | 0 | 0 | 1 |
| 9      | 22NVA\$06   | Employability Skills Training            | EEC      | 100      | 0             | 100         | 2          | 0 | 0 | 2 |
| 10     | 22NVA\$07   | Placement Training                       | EEC      | 100      | -             | 100         | 0          | 0 | 2 | 1 |
| 11     | 22NVA\$08   | Professional Skills and Career Readiness | EEC      | 100      | -             | 100         | 0          | 0 | 2 | 1 |

**GOVERNMENT COLLEGE OF TECHNOLOGY**  
**(An Autonomous Institution Affiliated to Anna University) Coimbatore–**  
**641013.**

**ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| 22NMC1Z0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | INDUCTION PROGRAMME | SEMESTER I |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|------------|
| <p>Details of the Programme:</p> <p>Day 0: College Admission</p> <p>Day1: Orientation Programme</p> <p>Day2 Onwards: Induction Programme</p> <p><b>Activities:</b><br/>Physical activity,<br/>Playground Events,<br/>Yoga Practices,<br/>Literary, Proficiency modules,<br/>Team Building,<br/>Lectures by Eminent people,<br/>Familiarization to department,<br/>Branch oriented information,<br/>Motivational speakers,<br/>Talent exposure,<br/>Quiz completion,<br/>Visit to local areas....etc.</p>  |                     |            |

|                 |                                                                             |                   |
|-----------------|-----------------------------------------------------------------------------|-------------------|
| <b>22NHS1Z1</b> | <b>தமிழர் மரபு</b><br><b>Heritage of Tamils</b><br>(Common to all Branches) | <b>SEMESTER I</b> |
|-----------------|-----------------------------------------------------------------------------|-------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>HSMC</b>     | <b>1</b> | <b>0</b> | <b>0</b> | <b>1</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                              |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------|
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>LANGUAGE AND LITERATURE</b>                                               | <b>3 Periods</b> |
| Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature- Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan. |                                                                              |                  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE</b>               | <b>3 Periods</b> |
| Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.                                                                                                                              |                                                                              |                  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>FOLK AND MARTIAL ARTS</b>                                                 | <b>3 Periods</b> |
| Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.                                                                                                                                                                                                                                                                                                                   |                                                                              |                  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>THINAI CONCEPT OF TAMILS</b>                                              | <b>3 Periods</b> |
| Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature- Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.                                                                                                                                                                                          |                                                                              |                  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE</b> | <b>3 Periods</b> |
| Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.                                                                                                                                                                                                  |                                                                              |                  |
| <b>Contact Periods:</b><br><b>Lecture: 15 Periods      Tutorial:0 Periods      Practical:0 Periods      Total: 15 Periods</b>                                                                                                                                                                                                                                                                                                                                        |                                                                              |                  |

**TEXT BOOK:**

|   |                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------|
| 1 | தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்). |
| 2 | கணிணித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).                                                          |
| 3 | கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)                                         |
| 4 | பொருதை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)                                                           |

**REFERENCES:**

|   |                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)                                              |
| 2 | Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies).               |
| 3 | Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu)(Published by: International Institute of Tamil Studies). |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|   |                                                                                                                                                                                           |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies).                                                              |
| 5 | Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu) |
| 6 | Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay)(Published by: The Author)                                                                            |
| 7 | Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)                                            |
| 8 | Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.                                                                                            |



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| 22NHS1Z1 | <b>தமிழர் மரபு</b><br><b>Heritage of Tamils</b><br>(Common to all Branches) | <b>SEMESTER I</b> |
|----------|-----------------------------------------------------------------------------|-------------------|

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|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>HSMC</b>     | <b>1</b> | <b>0</b> | <b>0</b> | <b>1</b> |

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| <b>அலகு I</b> | <b>மொழி மற்றும் இலக்கியம்</b> | <b>3 Periods</b> |
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இந்திய மொழிக் குடும்பங்கள்- திராவிட மொழிகள்- தமிழ் ஒரு செம்மொழி- தமிழ் செவ்விலக்கியங்கள் –சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை-சங்க இலக்கியத்தில் பகிர்தல் அறம்-திருக்குறளில் மேலாண்மைக் கருத்துக்கள்-தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்தசமயங்களின் தாக்கம்-பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள்-சிறுநிலக்கியங்கள்-தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி-தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

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| <b>அலகு II</b> | <b>மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை-சிற்பக் கலை</b> | <b>3 Periods</b> |
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நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்- பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள்-பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம் , பறை, வீணை, யாழ் , நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

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| <b>அலகு III</b> | <b>நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்</b> | <b>3 Periods</b> |
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தெருக்கூத்து, கரகாட்டம்-வில்லுப்பாட்டு-கணியான் கூத்து-ஒயிலாட்டம்-தோல்பாவைக் கூத்து-சிலம்பாட்டம் –வளரி-புலியாட்டம் -தமிழர்களின் விளையாட்டுகள்.

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| <b>அலகு IV</b> | <b>தமிழர்களின் திணைக் கோட்பாடுகள்</b> | <b>3 Periods</b> |
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தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு –சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் –சங்ககால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

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| <b>அலகு V</b> | <b>இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு</b> | <b>3 Periods</b> |
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இந்திய விடுதலைபோரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்ச வரலாறு.

**Contact Periods:****Lecture: 15 Periods      Tutorial:0 Periods      Practical:0 Periods      Total: 15 Periods****TEXT BOOK:**

|   |                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------|
| 1 | தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்). |
| 2 | கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).                                                          |

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| 3 | கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு) |
| 4 | பொருதை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)                   |

**REFERENCES:**

|   |                                                                                                                                                                                           |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)                                                                                             |
| 2 | Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies).                                                              |
| 3 | Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).                                               |
| 4 | The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies).                                                              |
| 5 | Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu) |
| 6 | Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)                                                                           |
| 7 | Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)                                            |
| 8 | Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.                                                                                            |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

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| <b>22NHS1Z2</b> | <b>PROFESSIONAL ENGLISH</b><br>(Common to all Branches) | <b>SEMESTER I</b> |
|-----------------|---------------------------------------------------------|-------------------|

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| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>HSMC</b>     | <b>2</b> | <b>1</b> | <b>0</b> | <b>3</b> |

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| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 1. To engage learners in meaningful language activities to improve their LSRW skills<br>2. To enhance learners' awareness of general rules of writing for specific audiences<br>3. To help learners understand the purpose, audience, contexts of different types of writing<br>4. To develop analytical thinking skills for problem solving in communicative contexts<br>5. To demonstrate an understanding of job applications and interviews for internship and placements |                  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>FUNDAMENTALS OF COMMUNICATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9 Periods</b> |
| Listening –Listening to Personal Introduction and Filling a form<br>Speaking - Self Introduction; Introducing someone in a formal context<br>Reading -Reading Biographies/ Autobiographies and E-mails relevant to technical contexts.<br>Writing - Writing Biographies/ Autobiographies; Drafting Professional E-mails.<br>Grammar - Present Tense (Simple Present, Present Progressive, Present Perfect, Present Perfect Continuous); Parts of Speech<br>Vocabulary - Word Formation with Prefixes; Antonyms; Portmanteau Words           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>SUMMATION AND PROBLEM SOLVING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>9 Periods</b> |
| Listening - Listening to Short-Stories / Personal Experiences/Watching Movies.<br>Speaking - Narrating Personal Experiences / Events and Short Stories<br>Reading - Reading Travelogues and Books.<br>Writing - Report on an event (Field Trip, Industrial Visit, Educational Tours etc.), Review on Books and Movies.<br>Grammar –Past Tense (Simple Past, Past Progressive, Past Perfect, Past Perfect Continuous); Impersonal Passive<br>Vocabulary - Word Formation with suffixes; Synonyms; Phrasal Verbs.                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
| <b>UNIT– III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>DESCRIPTION OF A PROCESS / PRODUCT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>9 Periods</b> |
| Listening - Listening to Digital Marketing Advertisements for Product /Process Descriptions<br>Speaking –Describing/Interpreting a Picture; Giving instructions to use the product.<br>Reading – Reading Advertisements, Gadget Reviews; User Manuals.<br>Writing - Writing Definitions; Product /Process Description; Transcoding; Content Writing<br>Grammar -Future Tense(Simple Future, future continuous, Future Perfect, Future Perfect Continuous); If Clauses<br>Vocabulary - Homonyms; Homophones, One Word Substitutes.           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
| <b>UNIT– IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>EXPRESSION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9 Periods</b> |
| Listening –Listening to/Watching Formal Job interviews or Celebrity Interviews<br>Speaking – Participating in a Face to Face or Virtual Interview (Job/Celebrity Interview), virtual interviews<br>Reading – Company profiles, Statement of Purpose, (SOP), Excerpts of interview with professionals from Newspaper, Magazine and other Resources<br>Writing – Job / Internship Application – Cover letter & Resume<br>Grammar – Question types: ‘Wh’ / Yes or No/ and Tags; Subject- Verb Agreement.<br>Vocabulary – Idiomatic Expressions |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>PUBLIC SPEAKING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>9 Periods</b> |
| Listening – Listening to Ceremonious Speeches on You Tube and Jotting down phrases<br>Speaking – Delivering Welcome Address; Introducing the Chief-Guest; Proposing Vote of Thank and                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

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| Felicitation<br>Reading – Excerpts of Speeches from Newspaper, Magazines and Motivational Books<br>Writing – Drafting a Welcome Address, Introduction to the Chief-Guest, Vote of Thanks and Felicitation<br>Grammar –Common Errors<br>Vocabulary – Commonly Confused Words |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                     |
| <b>Lecture: 30 Periods      Tutorial: 15 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                       |

### TEXT BOOK

|   |                                                                                                                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <b>English for Science &amp; Technology</b> Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University. |
| 2 | <b>Communicative English</b> , Global Publishers, Chennai 2017 by Dr.J.Anbazhagan Vijay                                                                                                                                                        |

### REFERENCES

|   |                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------|
| 1 | Raman.Meenakshi,Sharma.Sangeeta(2019). <b>Professional English</b> . Oxford University Press. New Delhi. |
| 2 | <b>Learning to Communicate</b> – Dr. V. Chellammal, Allied Publishing House, New Delhi,2003              |
| 3 | <b>Using English</b> , Orient Blackswan, Chennai, 2017 by Board of Editors                               |
| 4 | <b>OER</b> (Authentic Open Educational Resources)                                                        |

| COURSE OUTCOMES:                                           |                                                                                                                  | Bloom's Taxonomy Mapped |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|-------------------------|
| On completion of the course, the students will be able to: |                                                                                                                  |                         |
| CO1                                                        | Participate in a basic communicative task.                                                                       | K3                      |
| CO2                                                        | Analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format. | K3                      |
| CO3                                                        | Describe a product or process or mechanism.                                                                      | K2                      |
| CO4                                                        | Present their opinions in a planned and logical manner, and draft effective resumes in context of job search.    | K3                      |
| CO5                                                        | Deliver speeches at formal functions.                                                                            | K3                      |

### COURSE ARTICULATION MATRIX:

#### a) CO and PO Mapping:

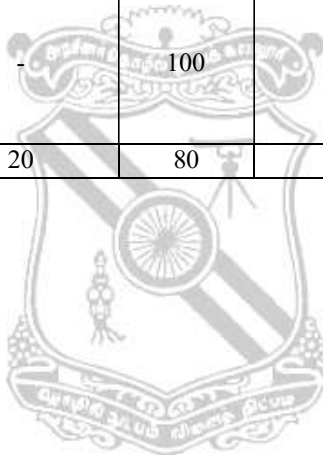
| COs/POs         | PO 1 | PO 2     | PO 3     | PO 4     | PO 5 | PO 6     | PO 7 | PO 8 | PO 9     | PO 10    | PO 11 | PO 12    | PSO 1 | PSO 2    | PSO 3    |
|-----------------|------|----------|----------|----------|------|----------|------|------|----------|----------|-------|----------|-------|----------|----------|
| CO1             | -    | -        | 1        | -        | -    | 2        | -    | -    | 3        | 3        | -     | -        | -     | -        | -        |
| CO2             | -    | 1        | 1        | -        | -    | 2        | -    | -    | 1        | 3        | -     | 1        | -     | -        | -        |
| CO3             | -    | -        | -        | 1        | -    | -        | -    | -    | -        | 3        | -     | -        | -     | -        | -        |
| CO4             | -    | -        | 1        | -        | -    | -        | -    | -    | 2        | 3        | -     | -        | -     | -        | -        |
| CO5             | -    | -        | -        | -        | -    | -        | -    | -    | 2        | 2        | -     | -        | -     | -        | -        |
| <b>22NHS1Z2</b> | -    | <b>1</b> | <b>1</b> | <b>1</b> | -    | <b>1</b> | -    | -    | <b>2</b> | <b>3</b> | -     | <b>1</b> | -     | <b>1</b> | <b>1</b> |

1 – Slight, 2 – Moderate, 3 – Substantial

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| <b>b) CO and Key Performance Indicators Mapping:</b> |                                                                                                  |
|------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| CO1                                                  | 3.3.2, 6.1.1, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2          |
| CO2                                                  | 2.1.1, 2.2.3, 2.2.4, 3.1.2, 6.2.1, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 12.3.1, 12.3.2 |
| CO3                                                  | 4.1.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2                                                    |
| CO4                                                  | 3.3.2, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2                        |
| CO5                                                  | 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.3, 10.2.1, 10.2.2                                              |

| <b>ASSESSMENT PATTERN – THEORY:</b>                          |                           |                             |                        |                         |                          |                        |                |
|--------------------------------------------------------------|---------------------------|-----------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------|
| <b>Test / Bloom's Category*</b>                              | <b>Remembering (K1) %</b> | <b>Understanding (K2) %</b> | <b>Applying (K3) %</b> | <b>Analyzing (K4) %</b> | <b>Evaluating (K5) %</b> | <b>Creating (K6) %</b> | <b>Total %</b> |
| CAT1                                                         | -                         | 12                          | 88                     | -                       | -                        | -                      | 100            |
| CAT2                                                         | -                         | 18                          | 82                     | -                       | -                        | -                      | 100            |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                         | -                           | 100                    | -                       | -                        | -                      | 100            |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                         | -                           | 100                    | -                       | -                        | -                      | 100            |
| ESE                                                          | -                         | 20                          | 80                     | -                       | -                        | -                      | 100            |



## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                |                   |
|-----------------|----------------------------------------------------------------|-------------------|
| <b>22NBS1Z1</b> | <b>LINEAR ALGEBRA AND CALCULUS</b><br>(Common to all Branches) | <b>SEMESTER I</b> |
|-----------------|----------------------------------------------------------------|-------------------|

| PREREQUISITES                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | CATEGORY | L | T | P | C           |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|-------------|
| NIL                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | BS       | 3 | 1 | 0 | 4           |
| Course Objectives                                                                                                                                                                                                                                                                    | 1. To acquire knowledge of system of equations, eigenvalues, eigenvectors, diagonalization of matrices and reduction of quadratic forms to canonical forms.<br>2. To obtain the knowledge of analyze the functions using Limits and derivative recognize the appropriate tools of differential calculus to solve applied problems.<br>3. To obtain the knowledge of definite and improper integration and recognize the appropriate tools of Integral Calculus to solve applied problems<br>4. To develop the skills in solving the functions of several variables by partial derivatives.<br>5. To acquire knowledge of multiple integration and related applied problems in various geometry |          |   |   |   |             |
| UNIT – I                                                                                                                                                                                                                                                                             | LINEAR ALGEBRA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |          |   |   |   | 9+3 Periods |
| Consistency of System of Linear Equations - Eigen values and eigenvectors - Diagonalization of matrices by orthogonal transformation - Cayley-Hamilton Theorem - Quadratic to canonical forms.                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |   |   |   |             |
| UNIT – II                                                                                                                                                                                                                                                                            | DIFFERENTIAL CALCULUS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |          |   |   |   | 9+3 Periods |
| Limit and continuity of function - Rolle's theorem - Mean value theorems - Taylor's and Maclaurin's theorems. Application of Differential Calculus: Radius of curvature, Centre of curvature, Circle of curvature and Evolutes of a curve.                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |   |   |   |             |
| UNIT – III                                                                                                                                                                                                                                                                           | INTEGRAL CALCULUS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |   |   |   | 9+3 Periods |
| Evaluation of definite integral by trigonometric substitution - Convergence and Divergence of improper integrals - Beta & Gamma functions and their properties - Applications of definite integrals to evaluate surface areas and volume of revolution (Cartesian coordinates only). |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |   |   |   |             |
| UNIT – IV                                                                                                                                                                                                                                                                            | PARTIAL DERIVATIVES AND ITS APPLICATIONS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |          |   |   |   | 9+3 Periods |
| Partial derivatives - total derivative - Taylor's series – Jacobians - Maxima, minima and saddle points - Method of Lagrange multipliers.                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |   |   |   |             |
| UNIT – V                                                                                                                                                                                                                                                                             | MULTI VARIABLE INTEGRAL CALCULUS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |          |   |   |   | 9+3 Periods |
| Double integral - Area as double integral - change of order of integration in double integrals - Triple Integrals - Volume as Triple Integral. Change of variables: Cartesian to polar, Spherical polar coordinates, Cylindrical polar coordinates.                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |   |   |   |             |
| Contact Periods :                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |   |   |   |             |
| Lecture: 45 Periods      Tutorial: 15 Periods      Practical: 0 Periods      Total: 60 Periods                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |   |   |   |             |

**TEXT BOOK**

|   |                                                                                                                 |
|---|-----------------------------------------------------------------------------------------------------------------|
| 1 | Veerarajan T., <b>“Engineering Mathematics I”</b> , Tata McGraw-Hill Education(India)Pvt. Ltd, New Delhi, 2015. |
| 2 | David C.Lay, <b>“Linear Algebra and Its Application”</b> , Pearson Publishers, 6 <sup>th</sup> Edition, 2021.   |

**REFERENCES**

|   |                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------|
| 1 | B.S.Grewal, <b>“Higher Engineering Mathematics”</b> , Khanna Publishers, 44 <sup>th</sup> Edition, 2017.              |
| 2 | Howard Anton, <b>“Elementry Linear Algebra”</b> , 11 <sup>th</sup> Edition, Wiley Publication, 2013.                  |
| 3 | Narayanan.S and Manicavachagom Pillai. T.K. – <b>“Calculus Vol I and Vol II”</b> , S.chand & Co, Sixth Edition, 2014. |
| 4 | H.K. Dass, <b>“Advance Engineering Mathematics”</b> , S. Chand and company, Eleventh Edition, 2015.                   |
| 5 | Jain R.K. and Iyengar S.R.K., <b>“Advanced Engineering Mathematics”</b> , Narosa Publicaitons, Eighth Edition, 2012.  |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES:</b>                                      |                                                                                                                                    | <b>Bloom's Taxonomy Mapped</b> |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                                                    |                                |
| CO1                                                          | Solve the linear system of equations, diagonalize matrix by orthogonal transformation and reduce quadratic form to canonical form. | K5                             |
| CO2                                                          | Compare and contrast the ideas of continuity and differentiability and use them to solve engineering problems.                     | K5                             |
| CO3                                                          | Acquire fluency in integration of one variable and apply them to find surface area and volumes.                                    | K5                             |
| CO4                                                          | Apply the techniques of partial derivatives in functions of several variables.                                                     | K5                             |
| CO5                                                          | Use multiple integration for finding area, surface and volume of different geometry.                                               | K5                             |

**COURSE ARTICULATION MATRIX:**

**a) CO and PO Mapping:**

| COs/POs                                   | P<br>O<br>1 | P<br>O<br>2 | P<br>O<br>3 | PO<br>4  | P<br>O<br>5 | P<br>O<br>6 | PO<br>7  | PO<br>8  | PO<br>9  | PO<br>10 | PO<br>11 | PO<br>12 | PS<br>O1 | PS<br>O2 | PSO<br>3 |
|-------------------------------------------|-------------|-------------|-------------|----------|-------------|-------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO1                                       | 3           | 3           | 1           | 1        | -           | -           | -        | -        | -        | -        | -        | 1        | 2        | 2        | 2        |
| CO2                                       | 3           | 3           | 1           | 1        | -           | -           | -        | -        | -        | -        | -        | 1        | 2        | 2        | 2        |
| CO3                                       | 3           | 3           | 1           | 1        | -           | -           | -        | -        | -        | -        | -        | 1        | 2        | 2        | 2        |
| CO4                                       | 3           | 3           | 1           | 1        | -           | -           | -        | -        | -        | -        | -        | 1        | 2        | 2        | 2        |
| CO5                                       | 3           | 3           | 1           | 1        | -           | -           | -        | -        | -        | -        | -        | 1        | 2        | 2        | 2        |
| <b>22NBS1Z1</b>                           | <b>3</b>    | <b>3</b>    | <b>1</b>    | <b>1</b> | <b>-</b>    | <b>-</b>    | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>3</b> | <b>3</b> | <b>3</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial |             |             |             |          |             |             |          |          |          |          |          |          |          |          |          |

**b) CO and Key Performance Indicators Mapping:**

|     |                                                                                                                        |
|-----|------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1 |
| CO2 | 1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1 |
| CO3 | 1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1 |
| CO4 | 1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1 |
| CO5 | 1.1.1, 1.1.2, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.2.1, 3.3.1, 4.1.1, 4.1.2, 12.2.1 |

**ASSESSMENT PATTERN – THEORY:**

| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                 | 40                   | 30              | 10               | -                 | -               | 100     |
| CAT2                                                         | 20                 | 40                   | 30              | 10               | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                 | 40                   | 30              | 10               | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                 | 40                   | 30              | 10               | -                 | -               | 100     |
| ESE                                                          | 20                 | 40                   | 30              | 10               | -                 | -               | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                        |                   |
|-----------------|--------------------------------------------------------|-------------------|
| <b>22NBS1Z2</b> | <b>ENGINEERING PHYSICS</b><br>(Common to all Branches) | <b>SEMESTER I</b> |
|-----------------|--------------------------------------------------------|-------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>BS</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                              | <ol style="list-style-type: none"><li>1. To understand the basics about crystal systems and defects</li><li>2. To understand the principle, characteristics, working and applications of laser and optical fiber</li><li>3. To solve problems in bending of beams</li><li>4. To solve quantum mechanical problems with the understanding of Quantum Principles</li><li>5. To understand the properties, production and applications of ultrasonic waves.</li></ol> |                  |  |
| <b>UNIT– I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>CRYSTAL PHYSICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9 Periods</b> |  |
| Introduction – Crystalline and amorphous materials – Lattice – Unit Cell –Crystal system - Bravais lattices – Miller indices – Reciprocal lattice - d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Crystal defects – Point, line and surface defects.                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>UNIT– II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>LASER PHYSICS AND FIBER OPTICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>9 Periods</b> |  |
| Introduction- Principle of laser action - characteristics of laser - Spontaneous emission and Stimulated emission –Einstein’s coefficients - population inversion – methods of achieving population inversion –Optical Resonator-Types of Lasers - Principle, construction and working of CO <sub>2</sub> Laser - applications of laser.                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| Introduction – Basic Principles involved in fiber optics- Total internal reflection–Propagation of light through optical fiber–Derivation for Numerical Aperture and acceptance angle - fractional index change                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>UNIT– III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>PROPERTIES OF MATTER</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>9 Periods</b> |  |
| Elasticity- Hooke’s law- stress-strain diagram - Factors affecting elasticity – Moment (Q) - Couple (Q) – Torque (Q) – Beam - Bending moment - Depression of a cantilever –Twisting Couple- Young’s modulus by uniform bending - I shaped girders.                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>UNIT– IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>QUANTUM PHYSICS AND APPLICATIONS</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>9 Periods</b> |  |
| Limitations of classical Physics - Introduction to Quantum theory - Dual nature of matter and radiation- de-Broglie wavelength in terms of voltage, energy and temperature–Heisenberg’s Uncertainty principle – verification – physical significance of a wave function- Schrödinger’s Time independent and Time dependent wave equations - Particle in a one dimensional potential well - Scanning Electron Microscope (SEM)-Transmission Electron Microscope (TEM). |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>UNIT– V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>ULTRASONICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>9 Periods</b> |  |
| Introduction - properties of ultrasonic waves - production of ultrasonic waves - Magnetostriction effect- Magnetostriction generator- Piezoelectric effect- Piezoelectric generator- Acoustic grating - Determination of wavelength and velocity of ultrasonic waves-cavitation - applications- ultrasonic drilling- ultrasonic welding- ultrasonic soldering and ultrasonic cleaning-Non- destructive Testing- Pulse echo system                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |

**TEXT BOOK:**

|   |                                                                                               |
|---|-----------------------------------------------------------------------------------------------|
| 1 | <i>K. Rajagopal, “Engineering Physics”, PHI Learning Private Limited, 2015.</i>               |
| 2 | <i>P. K. Palanisamy, “Engineering Physics-I”, Scitech publications Private Limited, 2015.</i> |
| 3 | <i>M. Arumugam, “Engineering Physics”, Anuradha Publishers, 2010.</i>                         |

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**REFERENCES:**

|   |                                                                                                                                          |
|---|------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Arthur Beiser, " <b>Concepts of Modern Physics</b> ", Tata McGraw-Hill, 2010.                                                            |
| 2 | D. Halliday, R. Resnick and J. Walker, " <b>Fundamentals of Physics</b> ", 6 <sup>th</sup> Edition, John Wiley and Sons, New York, 2001. |
| 3 | William T. Silfvast, " <b>Laser Fundamentals</b> ", Cambridge University Press, 2004.                                                    |
| 4 | M. N. Avadhanulu and P.G. Kshirsagar, " <b>A Textbook of Engineering Physics</b> ", S.Chand and Company Ltd, 2010.                       |
| 5 | R. K. Gaur and S. L. Gupta, " <b>Engineering Physics</b> ", Dhanpat Rai Publishers, 2009.                                                |

| COURSE OUTCOMES:                                             |                                                                                                                                                      | Bloom's Taxonomy Mapped |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                                                                      |                         |
| CO1                                                          | Interpret the crystal structure and analyse the type of defect                                                                                       | K4                      |
| CO2                                                          | Explain the principle, characteristics, working and applications of laser and optical fiber<br>Analyse and solve problems in laser and optical fiber | K4                      |
| CO3                                                          | Solve problems in bending of beams<br>Apply the knowledge in construction of buildings                                                               | K3                      |
| CO4                                                          | Explain the importance of quantum mechanics<br>Solve problems in basic quantum physics<br>Apply the wave equations in real time problems             | K3                      |
| CO5                                                          | Explain the properties and production of ultrasonic waves<br>Apply ultrasonic waves for industrial problems                                          | K3                      |

| COURSE ARTICULATION MATRIX:               |          |          |      |      |      |      |      |      |      |       |       |       |          |       |          |
|-------------------------------------------|----------|----------|------|------|------|------|------|------|------|-------|-------|-------|----------|-------|----------|
| a) CO and PO Mapping:                     |          |          |      |      |      |      |      |      |      |       |       |       |          |       |          |
| COs/POs                                   | PO 1     | PO 2     | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1    | PSO 2 | PSO 3    |
| CO1                                       | 2        | 2        | -    | -    | -    | -    | -    | -    | -    | -     | -     | -     | 1        | -     | 1        |
| CO2                                       | 3        | 1        | -    | -    | -    | -    | -    | -    | -    | -     | -     | -     | 1        | -     | 1        |
| CO3                                       | 3        | 2        | -    | -    | -    | -    | -    | -    | -    | -     | -     | -     | 1        | -     | 1        |
| CO4                                       | 2        | 2        | -    | -    | -    | -    | -    | -    | -    | -     | -     | -     | 1        | -     | 1        |
| CO5                                       | 2        | 1        | -    | -    | -    | -    | -    | -    | -    | -     | -     | -     | 1        | -     | 1        |
| <b>22NBS1Z2</b>                           | <b>3</b> | <b>2</b> | -    | -    | -    | -    | -    | -    | -    | -     | -     | -     | <b>1</b> | -     | <b>1</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial |          |          |      |      |      |      |      |      |      |       |       |       |          |       |          |

| b) CO and Key Performance Indicators Mapping: |                                                                             |
|-----------------------------------------------|-----------------------------------------------------------------------------|
| CO1                                           | 1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1                      |
| CO2                                           | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.3.1, 2.4.1                      |
| CO3                                           | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.1, 2.2.3, 2.2.4, 2.3.1, 2.4.1 |
| CO4                                           | 1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.3, 2.3.1, 2.4.1                      |
| CO5                                           | 1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.3.1, 2.4.1                             |

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| ASSESSMENT PATTERN – THEORY:                                 |                    |                      |                 |                  |                   |                 |         |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 30                 | 30                   | 15              | 15               | 10                | -               | 100     |
| CAT2                                                         | 30                 | 30                   | 15              | 15               | 10                | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 40                 | 40                   | 20              | -                | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 40                 | 40                   | 20              | -                | -                 | -               | 100     |
| ESE                                                          | 30                 | 30                   | 15              | 15               | 10                | -               | 100     |



## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                         |                   |
|-----------------|-------------------------------------------------------------------------|-------------------|
| <b>22NES101</b> | <b>PROGRAMMING IN C</b><br>(Common to all Branches except MECH & PRODN) | <b>SEMESTER I</b> |
|-----------------|-------------------------------------------------------------------------|-------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>ES</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                  |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                    | 1. To study the basic concepts of computer and programming fundamentals<br>2. To understand the data types in C, flow control statements, Arrays, Functions, Pointers, Structures, Unions and file concepts in C |                  |
| <b>UNIT- I</b>                                                                                                                                                                                                                                                              | <b>COMPUTER AND PROGRAMMING FUNDAMENTALS</b>                                                                                                                                                                     | <b>9 Periods</b> |
| Computer fundamentals – Evolution, classification, Anatomy of a computer: CPU, Memory, I/O – Introduction to software –Classification of programming languages – Compiling –Linking and loading a program – Introduction to OS – Types of OS                                |                                                                                                                                                                                                                  |                  |
| <b>UNIT- II</b>                                                                                                                                                                                                                                                             | <b>DATATYPES AND FLOW OF CONTROL</b>                                                                                                                                                                             | <b>9 Periods</b> |
| Structured programming – Algorithms – Structure of a C program – Variables – Data types – Operators and expressions – Input and Output statements – Tokens –Type Conversion – Control statements                                                                            |                                                                                                                                                                                                                  |                  |
| <b>UNIT- III</b>                                                                                                                                                                                                                                                            | <b>ARRAYS AND FUNCTIONS</b>                                                                                                                                                                                      | <b>9 Periods</b> |
| 1D Arrays–2D Arrays – Multidimensional Arrays – Strings – String handling functions – Functions – Recursion – Array as function arguments – Storage Classes – Enumerations.                                                                                                 |                                                                                                                                                                                                                  |                  |
| <b>UNIT- IV</b>                                                                                                                                                                                                                                                             | <b>POINTERS</b>                                                                                                                                                                                                  | <b>9 Periods</b> |
| Introduction to pointers – Pointers arithmetic – call by reference – Relationship between Array and Pointers – Relationship between String and pointers – pointers to pointers – array of pointers – pointers to an array – Dynamic memory allocation – Arguments to main() |                                                                                                                                                                                                                  |                  |
| <b>UNIT- V</b>                                                                                                                                                                                                                                                              | <b>STRUCTURES AND UNIONS, FILE OPERATIONS</b>                                                                                                                                                                    | <b>9 Periods</b> |
| Preprocessor directives – Structures – Unions – Bit fields – Opening and closing a file – Working with file of records – Random access to file of records.                                                                                                                  |                                                                                                                                                                                                                  |                  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                  |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                        |                                                                                                                                                                                                                  |                  |

**TEXT BOOK:**

|   |                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Pradip Dey, Manas Ghosh, “Computer Fundamentals and Programming in C”, Oxford University Press, Second Edition, 2018.</i> |
|---|------------------------------------------------------------------------------------------------------------------------------|

**REFERENCES:**

|   |                                                                                                                                          |
|---|------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Al Kelley, Ira Pohl, “A Book on C- Programming in C ”, 4<sup>th</sup> Edition , Addison Wesley,,2001.</i>                             |
| 2 | <i>Herbert Schildt , “C: The Complete Reference”, 4<sup>th</sup> Edition, McGraw Hill Education, 2017.</i>                               |
| 3 | <i>Yashavant P.Kanetkar, “ Let Us C”, 15<sup>th</sup> edition, BPB Publications, 2016.</i>                                               |
| 4 | <i>Brian W. Kernighan and Dennis Ritchie, “The C Programming Language”, 2<sup>nd</sup> Edition, Prentice Hall Software Series, 2015.</i> |

| <b>COURSE OUTCOMES:</b>                                      |                                                                                                            | <b>Bloom’s Taxonomy Mapped</b> |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                            |                                |
| CO1                                                          | Articulate the basics of computer and evolution of programming languages.                                  | K1                             |
| CO2                                                          | Write simple C programs using appropriate datatypes and control statements                                 | K3                             |
| CO3                                                          | Write C programs using arrays, functions and enumerations                                                  | K3                             |
| CO4                                                          | Use pointers effectively to develop programs                                                               | K3                             |
| CO5                                                          | Create user defined datatypes using structures & union and effectively manipulate them in file operations. | K6                             |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| <b>COURSE ARTICULATION MATRIX:</b>        |             |             |             |             |             |             |             |             |             |              |              |              |              |              |              |
|-------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>a) CO and PO Mapping:</b>              |             |             |             |             |             |             |             |             |             |              |              |              |              |              |              |
| <b>COs/POs</b>                            | <b>PO 1</b> | <b>PO 2</b> | <b>PO 3</b> | <b>PO 4</b> | <b>PO 5</b> | <b>PO 6</b> | <b>PO 7</b> | <b>PO 8</b> | <b>PO 9</b> | <b>PO 10</b> | <b>PO 11</b> | <b>PO 12</b> | <b>PSO 1</b> | <b>PSO 2</b> | <b>PSO 3</b> |
| CO1                                       | 1           | 3           | 1           | -           | -           | -           | -           | -           | -           | -            | -            | 1            | -            | -            | 1            |
| CO2                                       | 1           | 3           | 1           | -           | -           | -           | -           | -           | -           | -            | -            | 1            | -            | -            | 1            |
| CO3                                       | 1           | 3           | 1           | -           | -           | -           | -           | -           | -           | -            | -            | 1            | -            | -            | 1            |
| CO4                                       | 1           | 3           | 1           | -           | -           | -           | -           | -           | -           | -            | -            | 1            | -            | -            | 1            |
| CO5                                       | 1           | 3           | 1           | -           | -           | -           | -           | -           | -           | -            | -            | 1            | -            | -            | 1            |
| <b>22NES101</b>                           | <b>1</b>    | <b>3</b>    | <b>1</b>    | -           | -           | -           | -           | -           | -           | -            | -            | <b>1</b>     | -            | -            | <b>1</b>     |
| 1 – Slight, 2 – Moderate, 3 – Substantial |             |             |             |             |             |             |             |             |             |              |              |              |              |              |              |

| <b>b) CO and Key Performance Indicators Mapping:</b> |                                                                                                          |
|------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| CO1                                                  | 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 12.2.1        |
| CO2                                                  | 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2        |
| CO3                                                  | 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2 |
| CO4                                                  | 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2,       |
| CO5                                                  | 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.3, 3.2.3, 3.3.1, 12.1.2        |

| <b>ASSESSMENT PATTERN – THEORY:</b>                            |                          |                            |                       |                       |                         |                       |                |
|----------------------------------------------------------------|--------------------------|----------------------------|-----------------------|-----------------------|-------------------------|-----------------------|----------------|
| <b>Test / Bloom's Category*</b>                                | <b>Remembering (K1)%</b> | <b>Understanding (K2)%</b> | <b>Applying (K3)%</b> | <b>Analyzing (K4)</b> | <b>Evaluating (K5)%</b> | <b>Creating (K6)%</b> | <b>Total %</b> |
| CAT1                                                           | 50                       | 20                         | 30                    | -                     | -                       | -                     | 100            |
| CAT2                                                           | 20                       | 30                         | 50                    | -                     | -                       | -                     | 100            |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 | 50                       | -                          | 50                    | -                     | -                       | -                     | 100            |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 | -                        | -                          | 100                   | -                     | -                       | -                     | 100            |
| ESE                                                            | 20                       | 30                         | 50                    | -                     | -                       | -                     | 100            |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                          |                   |
|-----------------|--------------------------------------------------------------------------|-------------------|
| <b>22NMC1Z1</b> | <b>ENVIRONMENTAL SCIENCE AND ENGINEERING</b><br>(Common to all Branches) | <b>SEMESTER I</b> |
|-----------------|--------------------------------------------------------------------------|-------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>MC</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>0</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                 | 1. To study the modern agriculture related problems, natural resources and its harnessing methods.<br>2. To study the interrelationship between living organism and environment<br>3. To educate the people about causes of pollutions and its controlling methods.<br>4. To impart the knowledge of various environmental threats and its consequences.<br>5. To study the various water conservation methods, Act, Population policy, Welfare programs. |                  |  |
| <b>UNIT– I</b>                                                                                                                                                                                                                                                                                                                                                                                           | <b>ENVIRONMENTAL ENERGY RESOURCES</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>9 Periods</b> |  |
| Food-effects of modern agriculture, fertilizers, pesticides, eutrophication & biomagnifications-Energy resources: renewable resources - Hydro Energy, Solar & Wind. Non-renewable resources – Coal and Petroleum - harnessing methods                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>UNIT– II</b>                                                                                                                                                                                                                                                                                                                                                                                          | <b>ECO SYSTEM AND BIODIVERSITY</b>                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>9 Periods</b> |  |
| Eco system and its components - biotic and abiotic components. Biodiversity: types and values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity: In situ and ex situ conservation. Threats to biodiversity-destruction of habitat, habit fragmentation, hunting, over exploitation and man-wildlife conflicts. The IUCN red list categories.      |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>UNIT– III</b>                                                                                                                                                                                                                                                                                                                                                                                         | <b>ENVIRONMENTAL POLLUTION</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>9 Periods</b> |  |
| Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO <sub>2</sub> , NO <sub>2</sub> , H <sub>2</sub> S, CO, CO <sub>2</sub> and particulates. Water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollution. Noise pollution - decibel scale, sources, effects and control. |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>UNIT– IV</b>                                                                                                                                                                                                                                                                                                                                                                                          | <b>ENVIRONMENTAL THREATS</b>                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>9 Periods</b> |  |
| Global warming-measure to check global warming - impacts of enhanced Greenhouse effect, Acid rain- effects and control of acid rain, ozone layer depletion- effects of ozone depletion, disaster management - flood, drought, earthquake and tsunami.                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>UNIT– V</b>                                                                                                                                                                                                                                                                                                                                                                                           | <b>SOCIAL ISSUES AND ENVIRONMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>9 Periods</b> |  |
| Water conservation, rain water harvesting, e-waste management, Pollution Control Act, Wild life Protection Act. Population growth- exponential and logistic growth, variation in population among nations, population policy. Women and Child welfare programs. Role of information technology in human and health, COVID-19 - effects and preventive measures.                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>Contact Periods:</b><br><b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |

**TEXT BOOK:**

|   |                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Sharma J.P., “ <b>Environmental Studies</b> ”, 4 <sup>th</sup> Edition, University Science Press, New Delhi 2016.                                             |
| 2 | Anubha Kaushik and C.P.Kaushik, “ <b>Environmental Science and Engineering</b> ”, 7 <sup>th</sup> Edition, New Age International Publishers, New Delhi, 2021. |

**REFERENCES:**

|   |                                                                                                                                       |
|---|---------------------------------------------------------------------------------------------------------------------------------------|
| 1 | A K De, “ <b>Environmental Chemistry</b> ”, 8 <sup>th</sup> Edition, New Age International Publishers, 2017                           |
| 2 | G. Tyler Miller and Scott E. Spoolman, “ <b>Environmental Science</b> ”, Cengage Learning India Pvt, Ltd, Delhi, 2014                 |
| 3 | Erach Bharucha, “ <b>Textbook of Environmental Studies</b> ”, Universities Press(I) Pvt, Ltd, Hyderabad, 2015.                        |
| 4 | Gilbert M.Masters, “ <b>Introduction to Environmental Engineering and Science</b> ”, 3 <sup>rd</sup> Edition, Pearson Education, 2015 |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES:</b>                                      |                                                                                                                                                                  | <b>Bloom's Taxonomy Mapped</b> |
|--------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                                                                                  |                                |
| CO1                                                          | Recognize and understand about the various environmental energy resources and the effective utility of modern agriculture.                                       | K2                             |
| CO2                                                          | Acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.                                                 | K2                             |
| CO3                                                          | Be aware of the sources of various types of pollution, their ill effects and preventive methods.                                                                 | K2                             |
| CO4                                                          | Identify and take the preventive measures to control the environmental threats and effects of Global warming, Ozone depletion, Acid rain, and natural disasters. | K2                             |
| CO5                                                          | Demonstrate an idea to save water and other issues like COVID -19.                                                                                               | K2                             |

| <b>COURSE ARTICULATION MATRIX:</b>        |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>a) CO and PO Mapping:</b>              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| COs/POs                                   | PO 1     | PO 2     | PO 3     | PO 4     | PO 5     | PO 6     | PO 7     | PO 8     | PO 9     | PO 10    | PO 11    | PO 12    | PSO 1    | PSO 2    | PSO 3    |
| CO1                                       | 2        | 1        | 1        | 1        | -        | -        | 3        | -        | -        | -        | -        | -        | 1        | 1        | -        |
| CO2                                       | -        | -        | 1        | -        | -        | -        | 3        | -        | -        | -        | -        | -        | 1        | 1        | -        |
| CO3                                       | 2        | 1        | 1        | 1        | -        | -        | 3        | -        | -        | -        | -        | -        | 1        | 1        | -        |
| CO4                                       | 2        | 1        | 1        | 1        | -        | -        | 3        | -        | -        | -        | -        | -        | 1        | 1        | -        |
| CO5                                       | -        | 1        | 1        | 1        | -        | 2        | 3        | -        | -        | -        | -        | -        | 1        | 1        | -        |
| <b>22NMC1Z1</b>                           | <b>2</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>-</b> | <b>1</b> | <b>3</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>1</b> | <b>-</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

| <b>b) CO and Key Performance Indicators Mapping:</b> |                                                                                    |
|------------------------------------------------------|------------------------------------------------------------------------------------|
| CO1                                                  | 1.2.1, 1.4.1, 2.1.2, 2.3.1, 3.1.5, 3.2.1, 4.3.1, 7.1.1, 7.1.2, 7.2.1               |
| CO2                                                  | 3.1.5, 7.1.1, 7.1.2, 7.2.1                                                         |
| CO3                                                  | 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.3.1, 3.1.5, 3.2.1, 4.1.3, 4.3.1, 7.1.1, 7.1.2, 7.2.1 |
| CO4                                                  | 1.2.1, 1.4.1, 2.1.2, 2.3.1, 3.1.5, 4.1.3, 4.3.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2        |
| CO5                                                  | 2.1.2, 2.2.2, 3.1.5, 4.1.3, 4.3.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2               |

| <b>ASSESSMENT PATTERN – THEORY:</b>                          |                    |                      |                 |                  |                   |                 |         |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                 | 40                   | 20              | 20               | -                 | -               | 100     |
| CAT2                                                         | 20                 | 40                   | 20              | 20               | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                 | 40                   | 20              | 20               | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                 | 40                   | 20              | 20               | -                 | -               | 100     |
| ESE                                                          | 20                 | 40                   | 20              | 20               | -                 | -               | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                       |                   |
|-----------------|-------------------------------------------------------|-------------------|
| <b>22NBS1Z3</b> | <b>PHYSICS LABORATORY</b><br>(Common to all Branches) | <b>SEMESTER I</b> |
|-----------------|-------------------------------------------------------|-------------------|

|                      |                 |          |          |          |            |
|----------------------|-----------------|----------|----------|----------|------------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
| <b>NIL</b>           | <b>BS</b>       | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives</b> | <ol style="list-style-type: none"> <li>1. To impart practical knowledge on the concept of properties of matter and utilize the experimental techniques to measure the properties</li> <li>2. To impart practical knowledge on the moduli of elasticity</li> <li>3. To analyze the properties of semiconductors</li> <li>4. To learn practically the basic electronic concepts of transistor and logic gates</li> <li>5. To realize the principle, concepts and working of a solar cell and study the properties of ferromagnetic material</li> <li>6. To understand the concept of quantum physics</li> </ol> |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|               |                                                                                                                                     |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <b>S. No.</b> | <b>LABORATORY EXPERIMENTS:</b>                                                                                                      |
| 1.            | Determination of refractive index of the glass and given liquid – Spectrometer diffraction method                                   |
| 2.            | Determination of Planck's constant                                                                                                  |
| 3.            | Determination of Young's Modulus of the material in the form of bar – Cantilever Bending -Koenig's Method                           |
| 4.            | a) Particle size determination using diode laser<br>b) Determination of numerical aperture and acceptance angle in an optical fiber |
| 5.            | Hall effect - Determination of semiconductor parameters                                                                             |
| 6.            | Determination of band gap of semiconductor material                                                                                 |
| 7.            | Determination of velocity of sound and compressibility of the given liquid-Ultrasonic Interferometer                                |
| 8.            | Determination of moment of inertia of disc and rigidity modulus of a wire-Torsional pendulum                                        |
| 9.            | Transistor characteristics                                                                                                          |
| 10.           | Solar cell characteristics                                                                                                          |
| 11.           | Determination of Hysteresis losses in a Ferromagnetic material-B-H curve unit                                                       |
| 12.           | Logic Gates – Verification and Construction                                                                                         |

**Contact Periods:**

**Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods**

| <b>COURSE OUTCOMES:</b>                                      |                                                                                                                                                       | <b>Bloom's Taxonomy Mapped</b> |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                                                                       |                                |
| CO1                                                          | Determine refractive index and compressibility of liquids, micro size of particles and numerical aperture of an optical fibre                         | K5                             |
| CO2                                                          | Measure the Young's and rigidity moduli of the given material                                                                                         | K5                             |
| CO3                                                          | Determine the bandgap of a given semiconductor material and identify the type of semiconductor and its carrier concentration through Hall measurement | K5                             |
| CO4                                                          | Analyze the characteristics of transistor and verify the truth table of logic gates                                                                   | K4                             |
| CO5                                                          | Measure the efficiency of a solar cell and energy loss associated with the ferromagnetic material by plotting B-H curve                               | K5                             |
| CO6                                                          | Determine the Planck's constant and work function                                                                                                     | K5                             |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE ARTICULATION MATRIX:</b>        |             |             |             |             |             |             |             |             |             |              |              |              |              |              |              |
|-------------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>a) CO and PO Mapping:</b>              |             |             |             |             |             |             |             |             |             |              |              |              |              |              |              |
| <b>COs/POs</b>                            | <b>PO 1</b> | <b>PO 2</b> | <b>PO 3</b> | <b>PO 4</b> | <b>PO 5</b> | <b>PO 6</b> | <b>PO 7</b> | <b>PO 8</b> | <b>PO 9</b> | <b>PO 10</b> | <b>PO 11</b> | <b>PO 12</b> | <b>PS O1</b> | <b>PS O2</b> | <b>PS O3</b> |
| CO1                                       | 3           | 2           | -           | -           | -           | -           | -           | -           | -           | -            | -            | -            | 2            | -            | -            |
| CO2                                       | 3           | 2           | -           | -           | -           | -           | -           | -           | -           | -            | -            | -            | 2            | -            | -            |
| CO3                                       | 3           | 2           | -           | -           | -           | -           | -           | -           | -           | -            | -            | -            | 2            | -            | -            |
| CO4                                       | 3           | 2           | -           | -           | -           | -           | -           | -           | -           | -            | -            | -            | 2            | -            | -            |
| CO5                                       | 3           | 2           | -           | -           | -           | -           | -           | -           | -           | -            | -            | -            | 2            | -            | -            |
| CO6                                       | 3           | 2           | -           | -           | -           | -           | -           | -           | -           | -            | -            | -            | 2            | -            | -            |
| <b>22NBS1Z3</b>                           | <b>3</b>    | <b>2</b>    | <b>-</b>    | <b>-</b>    | <b>-</b>    | <b>-</b>    | <b>-</b>    | <b>-</b>    | <b>-</b>    | <b>-</b>     | <b>-</b>     | <b>-</b>     | <b>2</b>     | <b>-</b>     | <b>-</b>     |
| 1 – Slight, 2 – Moderate, 3 – Substantial |             |             |             |             |             |             |             |             |             |              |              |              |              |              |              |

| <b>b) CO and Key Performance Indicators Mapping:</b> |                                                                      |
|------------------------------------------------------|----------------------------------------------------------------------|
| CO1                                                  | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4 |
| CO2                                                  | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4 |
| CO3                                                  | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4 |
| CO4                                                  | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4 |
| CO5                                                  | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4 |
| CO6                                                  | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.4.1, 2.4.2, 2.4.3, 2.4.4 |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                      |                   |
|-----------------|------------------------------------------------------|-------------------|
| <b>22NES1Z2</b> | <b>WORKSHOP PRACTICE</b><br>(Common to all Branches) | <b>SEMESTER I</b> |
|-----------------|------------------------------------------------------|-------------------|

|                      |                 |          |          |          |            |
|----------------------|-----------------|----------|----------|----------|------------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
| <b>NIL</b>           | <b>ES</b>       | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives</b> | <ol style="list-style-type: none"> <li>To make various basic prototypes in the carpentry trade such as Half Lap joint, Lap Tee joint, Dovetail joint, Mortise &amp; Tenon joint.</li> <li>To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint.</li> <li>To make various mould in foundry such as Cube, Straight pipe, V pulley, and Conical bush.</li> <li>To make various components using sheet metal such as Tray, Frustum of cone and Square box.</li> <li>To understand the working and identify the various components of CNC Machines</li> </ol> |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|               |                                                                                             |
|---------------|---------------------------------------------------------------------------------------------|
| <b>S. No.</b> | <b>LIST OF EXPERIMENTS</b>                                                                  |
| 1.            | Introduction to use of tools and equipment's in Carpentry, Welding, Foundry and Sheet metal |
| 2.            | Safety aspects in Welding, Carpentry, Foundry and sheet metal.                              |
| 3.            | Half Lap joint and Dovetail joint in Carpentry.                                             |
| 4.            | Welding of Lap joint and Butt joint and T-joint.                                            |
| 5.            | Preparation of Sand mould for Cube, Conical bush, Pipes and V pulley                        |
| 6.            | Fabrication of parts like Tray, Frustum of cone and Square box in sheet metal               |
| 7.            | CNC Machines demonstration and lecture on working principle.                                |
| 8.            | Electrical wiring and simple house wiring.                                                  |

**Contact Periods:**

**Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods**

|                                                              |                                                                                                              |                                |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------|
| <b>COURSE OUTCOMES:</b>                                      |                                                                                                              | <b>Bloom's Taxonomy Mapped</b> |
| Upon completion of the course, the students will be able to: |                                                                                                              |                                |
| CO1                                                          | Safely Use tools and equipment's used in Carpentry, Welding, Foundry and Sheet metal to create basic joints. | K2                             |
| CO2                                                          | Prepare sand mould for various basic pattern shapes.                                                         | K3                             |
| CO3                                                          | Fabricate parts like Tray, Frustum of cone and Square box in sheet metal.                                    | K3                             |
| CO4                                                          | Practice on the Welding and Carpentry                                                                        | K3                             |
| CO5                                                          | Demonstrate the working of CNC Machines.                                                                     | K2                             |

**COURSE ARTICULATION MATRIX:**

**a) CO and PO Mapping:**

| COs/POs         | PO 1     | PO 2     | PO 3     | PO 4     | PO 5     | PO 6     | PO 7     | PO 8     | PO 9     | PO 10    | PO 11    | PO 12    | PS O1    | PS O2    | PS O3    |
|-----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO1             | 2        | 2        | 3        | 2        | 1        | 3        | 1        | 2        | 3        | 3        | 2        | 3        | -        | 1        | -        |
| CO2             | 2        | 2        | 3        | 2        | 1        | 3        | 3        | 2        | 3        | 3        | 2        | 3        | -        | 1        | -        |
| CO3             | 2        | 2        | 3        | 2        | 1        | 3        | 3        | 2        | 3        | 3        | 2        | 3        | -        | 1        | -        |
| CO4             | 2        | 2        | 3        | 2        | 1        | 3        | 3        | 2        | 3        | 3        | 2        | 3        | 1        | 1        | 1        |
| CO5             | 2        | 2        | 3        | 2        | 3        | -        | -        | 2        | 3        | 3        | 2        | 2        | -        | 1        | 1        |
| <b>22NES1Z2</b> | <b>2</b> | <b>2</b> | <b>3</b> | <b>2</b> | <b>2</b> | <b>3</b> | <b>2</b> | <b>2</b> | <b>3</b> | <b>3</b> | <b>2</b> | <b>3</b> | <b>1</b> | <b>1</b> | <b>1</b> |

1 – Slight, 2 – Moderate, 3 – Substantial

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| <b>b) CO and Key Performance Indicators Mapping :</b> |                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                                   | 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2               |
| CO2                                                   | 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2 |
| CO3                                                   | 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2 |
| CO4                                                   | 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.2.2, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.1.1, 12.2.2, 12.3.1, 12.3.2 |
| CO5                                                   | 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 4.1.1, 4.1.4, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.2, 7.1.1, 7.2.2, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.3.1, 12.2.2, 12.3.1, 12.3.2         |



|                           |                                                                                                                                                                                                              |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives</b>  | To understand the concepts like Data types, Flow control statements, Functions, Arrays, command line arguments, Pointer, Dynamic memory allocation, Preprocessor Directives, Structures, Unions, Files in C. |
| <b>S. No.</b>             | <b>EXERCISES ILLUSTRATING THE FOLLOWING CONCEPTS:</b>                                                                                                                                                        |
| 1.                        | Operators, Expressions and IO formatting                                                                                                                                                                     |
| 2.                        | Decision Making and Looping                                                                                                                                                                                  |
| 3.                        | Arrays and Strings                                                                                                                                                                                           |
| 4.                        | Functions and Recursion                                                                                                                                                                                      |
| 5.                        | Pointers                                                                                                                                                                                                     |
| 6.                        | Dynamic Memory Allocation                                                                                                                                                                                    |
| 7.                        | Command line arguments                                                                                                                                                                                       |
| 8.                        | Preprocessor Directives                                                                                                                                                                                      |
| 9.                        | Structures                                                                                                                                                                                                   |
| 10.                       | Unions                                                                                                                                                                                                       |
| 11.                       | Files                                                                                                                                                                                                        |
| 12.                       | Mini Project                                                                                                                                                                                                 |
| <b>Contact Periods:</b>   |                                                                                                                                                                                                              |
| <b>Lecture: 0 Periods</b> | <b>Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods</b>                                                                                                                                 |

| COURSE ARTICULATION MATRIX: |          |          |          |          |      |      |      |      |          |          |       |       |       |       |          |
|-----------------------------|----------|----------|----------|----------|------|------|------|------|----------|----------|-------|-------|-------|-------|----------|
| a) CO and PO Mapping:       |          |          |          |          |      |      |      |      |          |          |       |       |       |       |          |
| COs/POs                     | PO 1     | PO 2     | PO 3     | PO 4     | PO 5 | PO 6 | PO 7 | PO 8 | PO 9     | PO 10    | PO 11 | PO 12 | PS O1 | PS O2 | PS O3    |
| CO1                         | 2        | 3        | 1        | 1        | -    | -    | -    | -    | -        | -        | -     | -     | -     | -     | 1        |
| CO2                         | 2        | 3        | 1        | 1        | -    | -    | -    | -    | -        | -        | -     | -     | -     | -     | 1        |
| CO3                         | 2        | 3        | 1        | 1        | -    | -    | -    | -    | -        | -        | -     | -     | -     | -     | 1        |
| CO4                         | 2        | 3        | 1        | 1        | -    | -    | -    | -    | -        | -        | -     | -     | -     | -     | 1        |
| CO5                         | 2        | 3        | 2        | 1        | -    | -    | -    | -    | 3        | 3        | -     | 1     | -     | -     | 1        |
| <b>22NES103</b>             | <b>2</b> | <b>3</b> | <b>2</b> | <b>1</b> | -    | -    | -    | -    | <b>1</b> | <b>1</b> | -     | 1     | -     | -     | <b>1</b> |

1 – Slight, 2 – Moderate, 3 –Substantial

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| b) CO and Key Performance Indicators Mapping |                                                                                                                              |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| CO1                                          | 1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1        |
| CO2                                          | 1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1        |
| CO3                                          | 1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1 |
| CO4                                          | 1.1.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.2.1               |
| CO5                                          | 1.1.1, 1.2.1, 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.1, 2.4.3, 2.4.4, 3.1.1, 3.1.5, 3.1.6, 3.2.3, 3.3.1        |



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| 22NHS2Z4 | தமிழரும் தொழில் நுட்பமும்<br>TAMILS AND TECHNOLOGY<br>(Common to all Branches) | SEMESTER II |
|----------|--------------------------------------------------------------------------------|-------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | HSMC     | 1 | 0 | 0 | 1 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                               |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------|
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>WEAVING AND CERAMIC TECHNOLOGY</b>         | <b>3 Periods</b> |
| Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW)– Graffiti on Potteries.                                                                                                                                                                                                                                                                                                                                                               |                                               |                  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>DESIGN AND CONSTRUCTION TECHNOLOGY</b>     | <b>3 Periods</b> |
| Designing and Structural construction House & Designs in household materials during Sangam Age- Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period. |                                               |                  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>MANUFACTURING TECHNOLOGY</b>               | <b>3 Periods</b> |
| Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beads - Archeological evidences - Gem stone types described in Silappathikaram.                                                                                                                                                       |                                               |                  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>AGRICULTURE AND IRRIGATION TECHNOLOGY</b>  | <b>3 Periods</b> |
| Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.                                                                                                                                                                                                    |                                               |                  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>SCIENTIFIC TAMIL &amp; TAMIL COMPUTING</b> | <b>3 Periods</b> |
| Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.                                                                                                                                                                                                                                                                  |                                               |                  |
| <b>Contact Periods:</b><br><b>Lecture: 15Periods      Tutorial:0 Periods      Practical:0Periods      Total: 15Periods</b>                                                                                                                                                                                                                                                                                                                                                         |                                               |                  |

**TEXT BOOK:**

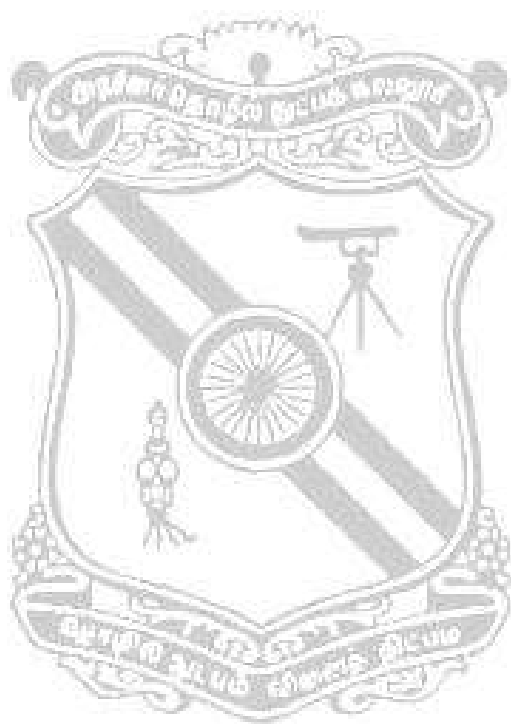
|   |                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------|
| 1 | தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்). |
| 2 | கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).                                                          |
| 3 | கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)                                         |
| 4 | பொருதை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)                                                           |

**REFERENCES:**

|   |                                                                                                                                             |
|---|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)                                               |
| 2 | Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies).                |
| 3 | Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies). |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|   |                                                                                                                                                                                           |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4 | The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies).                                                              |
| 5 | Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu) |
| 6 | Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)                                                                           |
| 7 | Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)                                            |
| 8 | Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.                                                                                            |



|          |                                                                                |             |
|----------|--------------------------------------------------------------------------------|-------------|
| 22NHS2Z4 | தமிழரும் தொழில் நுட்பமும்<br>TAMILS AND TECHNOLOGY<br>(Common to all Branches) | SEMESTER II |
|----------|--------------------------------------------------------------------------------|-------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | HSMC     | 1 | 0 | 0 | 1 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                     |                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|------------------|
| <b>அலகு I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>நெசவு மற்றும் பானைத் தொழில்நுட்பம்</b>           | <b>3 Periods</b> |
| சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள்- பாண்டங்களில் கீறல் குறியீடுகள்.                                                                                                                                                                                                                                                                                                                                                                                                        |                                                     |                  |
| <b>அலகு II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்</b>    | <b>3 Periods</b> |
| சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும்- சிலப்பதிகாரத்தில் மேடைஅமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும்-சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள்- மாதிரிகட்டமைப்புகள் பற்றி அறிதல் , மதுரை மீனாட்சிஅம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை. |                                                     |                  |
| <b>அலகு III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>உற்பத்தித் தொழில் நுட்பம்</b>                    | <b>3 Periods</b> |
| கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் –நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள் , கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் –தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைககள்.                                                                                                                                                                                |                                                     |                  |
| <b>அலகு IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்</b> | <b>3 Periods</b> |
| அணை, ஏரி, குளங்கள் , மதகு – சோழர்காலக் குழுவித்தாம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார்அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு –அறிவுசார் சமூகம்.                                                                                                                                                                                                              |                                                     |                  |
| <b>அலகு V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்</b>          | <b>3 Periods</b> |
| அறிவியல் தமிழின் வளர்ச்சி- கணினித்தமிழ் வளர்ச்சி- தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.                                                                                                                                                                                                                                                                                                   |                                                     |                  |
| <b>Contact Periods:</b><br><b>Lecture: 15Periods      Tutorial: 0 Periods      Practical:0Periods      Total: 15Periods</b>                                                                                                                                                                                                                                                                                                                                                                                               |                                                     |                  |

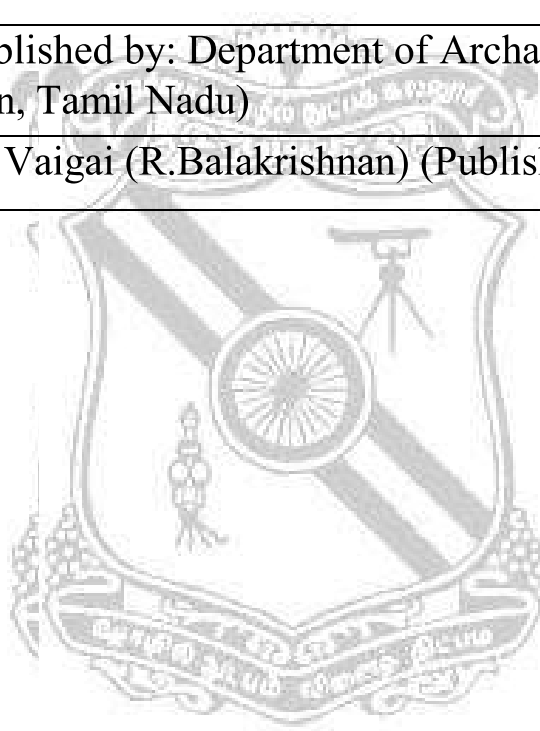
**TEXT BOOK:**

|   |                                                                                                                  |
|---|------------------------------------------------------------------------------------------------------------------|
| 1 | தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்). |
| 2 | கணினித்தமிழ் – முனைவர் இல.சுந்தரம் . (விகடன் பிரசுரம்).                                                          |

|   |                                                                          |
|---|--------------------------------------------------------------------------|
| 3 | கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு) |
| 4 | பொருதை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)                   |

**REFERENCES:**

|   |                                                                                                                                                                                           |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)                                                                                             |
| 2 | Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by:International Institute of Tamil Studies).                                                              |
| 3 | Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).                                               |
| 4 | The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by:International Institute of Tamil Studies.)                                                              |
| 5 | Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by:Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation,Tamil Nadu) |
| 6 | Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)                                                                           |
| 7 | Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)                                            |
| 8 | Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.                                                                                            |



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| <b>22NHS2Z5</b> | <b>VALUES AND ETHICS</b><br>(Common to all Branches) | <b>SEMESTER II</b> |
|-----------------|------------------------------------------------------|--------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>HSMC</b>     | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                              |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                    | 1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity<br>2. To learn about Engineering Ethics and case studies<br>3. To understand the negative health impacts of certain unhealthy behaviors<br>4. To appreciate the need and importance of physical, emotional health and social health<br>5. To get familiar with the global issues |                  |  |
| <b>UNIT– I</b>                                                                                                                                                                                                                                                                                                                                                                              | <b>BEING GOOD AND RESPONSIBLE</b>                                                                                                                                                                                                                                                                                                                                                            | <b>9 Periods</b> |  |
| Morals, Values and Ethics - Integrity - Work Ethics - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Cooperation - Commitment - Empathy - Self-Confidence - Character                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                              |                  |  |
| <b>UNIT– II</b>                                                                                                                                                                                                                                                                                                                                                                             | <b>ENGINEERING AS SOCIAL EXPERIMENTATION</b>                                                                                                                                                                                                                                                                                                                                                 | <b>9 Periods</b> |  |
| Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Models of Professional Roles.<br>Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – Case studies: Chernobyl disaster and Titanic disaster |                                                                                                                                                                                                                                                                                                                                                                                              |                  |  |
| <b>UNIT– III</b>                                                                                                                                                                                                                                                                                                                                                                            | <b>ADDICTION AND HEALTH</b>                                                                                                                                                                                                                                                                                                                                                                  | <b>9 Periods</b> |  |
| Peer pressure - Alcoholism: Ethical values, causes, impact, laws, prevention – Ill effects of smoking - Prevention of Suicides; Sexual Health: Prevention and impact of pre-marital pregnancy and Sexually Transmitted Diseases.<br>Drug Abuse: Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention                                    |                                                                                                                                                                                                                                                                                                                                                                                              |                  |  |
| <b>UNIT– IV</b>                                                                                                                                                                                                                                                                                                                                                                             | <b>PROFESSIONAL ETHICS</b>                                                                                                                                                                                                                                                                                                                                                                   | <b>9 Periods</b> |  |
| Abuse of Technologies: Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                              |                  |  |
| <b>UNIT– V</b>                                                                                                                                                                                                                                                                                                                                                                              | <b>GLOBAL ISSUES</b>                                                                                                                                                                                                                                                                                                                                                                         | <b>9 Periods</b> |  |
| Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers - consulting engineers - engineers as expert witnesses and advisors - Code of Conduct – Corporate Social Responsibility                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                              |                  |  |
| <b>Contact Periods:</b><br><b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                              |                  |  |

**TEXT BOOK:**

|   |                                                                                                                               |
|---|-------------------------------------------------------------------------------------------------------------------------------|
| 1 | Mike W Martin and Roland Schinzinger, " <b>Ethics in Engineering</b> ", McGraw-Hill, New York, 4 <sup>th</sup> Edition, 2017. |
| 2 | Govindarajan M, Natarajan S and Senthil Kumar VS, " <b>Engineering Ethics</b> ", Prentice Hall of India, New Delhi, 2013.     |

**REFERENCES:**

|   |                                                                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Dhaliwal, K.K, " <b>Gandhian Philosophy of Ethics: A Study of Relationship between his Presupposition and Precepts</b> ", Writers Choice, New Delhi, India, 2016. |
| 2 | Jayshree suresh, B.S.Raghavan, " <b>Human values and professional ethics</b> ," S.Chand & company Ltd, New Delhi, 2 <sup>nd</sup> Edition, 2007.                  |
| 3 | L.A. and Pagliaro, A.M, " <b>Handbook of Child and Adolescent Drug and Substance Abuse:</b>                                                                       |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|   |                                                                                                                                              |
|---|----------------------------------------------------------------------------------------------------------------------------------------------|
|   | <i>Pharmacological, Developmental and Clinical Considerations</i> , Wiley Publishers, U.S.A 2012.                                            |
| 4 | Pandey, P. K(2012), <i>“Sexual Harassment and Law in India”</i> , Lambert Publishers, Germany 2012.                                          |
| 5 | Kiran D.R, <i>“Professional ethics and Human values,”</i> Tata McGraw Hill, New Delhi, 2007.                                                 |
| 6 | Edmund G See Bauer and Robert L Barry, <i>“Fundamentals of Ethics for Scientists and Engineers”</i> , Oxford University Press, Oxford, 2001. |
| 7 | David Ermann and Michele S Shauf, <i>“Computers, Ethics and Society”</i> , Oxford University Press, 2003.                                    |
| 8 | Govindarajan M, Natarajan S, Senthil Kumar V. S, <i>“Engineering Ethics”</i> , Prentice Hall of India, New Delhi, 2004.                      |

| COURSE OUTCOMES:                                             |                                                                                         | Bloom's Taxonomy Mapped |
|--------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------|
| Upon completion of the course, the students will be able to: |                                                                                         |                         |
| CO1                                                          | Follow sound morals and ethical values scrupulously to prove as good citizens           | K3                      |
| CO2                                                          | Assess the relevance of ethics and morals in engineering and to learn case studies      | K3                      |
| CO3                                                          | Describe the concept of addiction and how it will affect the physical and mental health | K2                      |
| CO4                                                          | Identify ethical concerns while using advanced technologies                             | K2                      |
| CO5                                                          | Judge the code of conduct, Environmental ethics and computer ethics                     | K3                      |

| COURSE ARTICULATION MATRIX:               |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
|-------------------------------------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| a) CO and PO Mapping:                     |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| COs/POs                                   | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
| CO1                                       | -    | -    | -    | -    | -    | 3    | 3    | 3    | 3    | 3     | 3     | -     | 1     | 1     | 1     |
| CO2                                       | -    | -    | -    | -    | -    | 3    | 1    | 3    | 3    | -     | -     | -     | 1     | 1     | 1     |
| CO3                                       | -    | -    | -    | -    | -    | 3    | 1    | 3    | 3    | 2     | 3     | -     | -     | -     | -     |
| CO4                                       | -    | -    | -    | -    | -    | 3    | 3    | 3    | 3    | 1     | 3     | 1     | 1     | 1     | 1     |
| CO5                                       | -    | -    | -    | -    | -    | 3    | 3    | 3    | 3    | -     | 1     | 3     | 1     | 1     | 1     |
| 22NHS2Z5                                  | -    | -    | -    | -    | -    | 3    | 3    | 3    | 3    | 2     | 2     | 1     | 1     | 1     | 1     |
| 1 – Slight, 2 – Moderate, 3 – Substantial |      |      |      |      |      |      |      |      |      |       |       |       |       |       |       |

| b) CO and Key Performance Indicators Mapping: |                                                                                                                                                                                                        |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                           | 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1 |
| CO2                                           | 6.1.1, 6.2.1, 7.1.1, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1                                                                                                              |
| CO3                                           | 6.1.1, 6.2.1, 7.1.1, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.2.1, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1                                                      |
| CO4                                           | 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1                         |
| CO5                                           | 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 11.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2                                         |

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| <b>ASSESSMENT PATTERN – THEORY:</b>                          |                           |                             |                        |                         |                          |                        |                |
|--------------------------------------------------------------|---------------------------|-----------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------|
| <b>Test / Bloom's Category*</b>                              | <b>Remembering (K1) %</b> | <b>Understanding (K2) %</b> | <b>Applying (K3) %</b> | <b>Analyzing (K4) %</b> | <b>Evaluating (K5) %</b> | <b>Creating (K6) %</b> | <b>Total %</b> |
| CAT1                                                         | 30                        | 30                          | 20                     | 20                      | -                        | -                      | 100            |
| CAT2                                                         | 30                        | 30                          | 20                     | 20                      | -                        | -                      | 100            |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                        | 30                          | 20                     | 20                      | -                        | -                      | 100            |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                        | 30                          | 20                     | 20                      | -                        | -                      | 100            |
| ESE                                                          | 30                        | 30                          | 20                     | 20                      | -                        | -                      | 100            |



## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                                                 |                    |
|-----------------|-------------------------------------------------------------------------------------------------|--------------------|
| <b>22NBS204</b> | <b>DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS</b><br>(Common to all Branches except CSE & IT) | <b>SEMESTER II</b> |
|-----------------|-------------------------------------------------------------------------------------------------|--------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>BS</b>       | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

|                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                          | 1. To gain knowledge of methods to solve higher order differential equations with constant and variable coefficients.<br>2. To be familiar with forming partial differential equations and solving partial differential equations of standard types of first order and homogeneous linear differential equations.<br>3. To be familiar with numerical interpolation, numerical differentiation and numerical integration.<br>4. To acquire the knowledge of numerical solution to first order ordinary differential equations using single and multi step techniques.<br>5. To gain the knowledge of numerical solution to second order partial differential equations using explicit and implicit methods. |                    |  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                                                   | <b>ORDINARY DIFFERENTIAL EQUATIONS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>9+3 Periods</b> |  |
| Higher order linear differential equations with constant coefficients -variable coefficients: Cauchy-Euler equation, Cauchy-Legendre equation-Method of variation of parameters-Simultaneous first order linear equations with constant coefficients.                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                                                  | <b>PARTIAL DIFFERENTIAL EQUATIONS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>9+3 Periods</b> |  |
| Formation of partial differential equations – First order partial differential equations – Standard types and Lagrange’s type – Homogeneous linear partial differential equation of second and higher order with constant coefficients.                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                                                                 | <b>INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>9+3 Periods</b> |  |
| Solution of polynomial and transcendental equations: Newton-Raphson method-Interpolation with equal interval: Newton’s forward and backward difference formulae-Interpolation with unequal intervals: Lagrange’s formulae-Numerical Differentiation; Newton’s formulae-Numerical integration: Trapezoidal rule and Simpson’s 1/3rd and 3/8 rules. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                                                                  | <b>NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>9+3 Periods</b> |  |
| First order ordinary differential equations: Taylor’s series method-Euler and modified Euler’s methods-Runge- Kutta method of fourth order -Milne’s and Adam’s predictor-corrector methods.                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                                                   | <b>NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>9+3 Periods</b> |  |
| Partial differential equations: Finite difference method for two dimensional Laplace equation and Poisson equation- Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods)-Finite difference explicit method for wave equation.                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |  |
| <b>Lecture: 45 Periods      Tutorial: 15 Periods      Practical: 0 Periods      Total: 60 Periods</b>                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                    |  |

**TEXT BOOK:**

|   |                                                                                                                                        |
|---|----------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Veerarajan.T, “Engineering Mathematics”, Revised Edition 2018, McGraw Hill Education (India) Private Limited</i>                    |
| 2 | <i>P. Kandasamy, K. Thilagavathy, K. Gunavathi, “Numerical Methods”, S. Chand &amp; Company, 3<sup>rd</sup> Edition, Reprint 2013.</i> |

**REFERENCES:**

|   |                                                                                                                                                  |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | B.S.Grewal, " <b>Higher Engineering Mathematics</b> ", Khanna Publishers, New Delhi, 44 <sup>th</sup> Edition, 2018.                             |
| 2 | SrimantaPal, " <b>Numerical Methods Principles, Analyses and Algorithms</b> ", Oxford University Press, New Delhi, 1 <sup>st</sup> Edition 2009. |
| 3 | Raisinghania.M.D, " <b>Ordinary And Partial Differential Equations</b> ", 20th Edition, S. Chand Publishing, 2020                                |
| 4 | S.S. Sastry, " <b>Introductory methods of numerical analysis</b> ", PHI, New Delhi, 5 <sup>th</sup> Edition, 2015.                               |
| 5 | Ward Cheney, David Kincaid, " <b>Numerical Methods and Computing</b> ", Cengage Learning, Delhi, 7 <sup>th</sup> Edition 2013.                   |
| 6 | S. Larsson, V. Thomee, " <b>Partial Differential Equations with Numerical Methods</b> ", Springer, 2003.                                         |

| COURSE OUTCOMES:                                             |                                                                                                                                 | Bloom's Taxonomy Mapped |
|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                                                 |                         |
| CO1                                                          | Solve higher order linear differential equation with constant and variable coefficients and simultaneous differential equation. | K5                      |
| CO2                                                          | Form partial differential equations and find solutions of first and higher order partial differential equations.                | K5                      |
| CO3                                                          | Obtain approximate solutions for transcendental equations and problems on interpolation, differentiation, integration.          | K5                      |
| CO4                                                          | Find the numerical solutions of first order ordinary differential equations using single and multi step techniques.             | K5                      |
| CO5                                                          | Solve second order partial differential equations using explicit and implicit methods.                                          | K5                      |

**COURSE ARTICULATION MATRIX:****a) CO and PO Mapping:**

| COs/POs                                   | PO 1     | PO 2     | PO 3     | PO 4     | PO 5     | PO 6     | PO 7     | PO 8     | PO 9     | PO 10    | PO 11    | PO 12    | PS O1    | PS O2    | PS O3    |
|-------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO1                                       | 3        | 3        | -        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 2        | 1        |
| CO2                                       | 3        | 3        | -        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 2        | 1        |
| CO3                                       | 3        | 3        | -        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 2        | 1        |
| CO4                                       | 3        | 3        | -        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 2        | 1        |
| CO5                                       | 3        | 3        | -        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 2        | 1        |
| <b>22NBS204</b>                           | <b>3</b> | <b>3</b> | <b>-</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>1</b> | <b>2</b> | <b>1</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

**b) CO and Key Performance Indicators Mapping:**

|     |                                                                                                                        |
|-----|------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1, 12.2.1 |
| CO2 | 1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1, 12.2.1 |
| CO3 | 1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1, 12.2.1 |
| CO4 | 1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1, 12.2.1 |
| CO5 | 1.1.1, 1.1.2, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 4.1.1, 12.2.1 |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>ASSESSMENT PATTERN – THEORY :</b>                         |                           |                             |                        |                         |                          |                        |                |
|--------------------------------------------------------------|---------------------------|-----------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------|
| <b>Test / Bloom's Category*</b>                              | <b>Remembering (K1) %</b> | <b>Understanding (K2) %</b> | <b>Applying (K3) %</b> | <b>Analyzing (K4) %</b> | <b>Evaluating (K5) %</b> | <b>Creating (K6) %</b> | <b>Total %</b> |
| CAT1                                                         | 20                        | 40                          | 20                     | 20                      | -                        | -                      | 100            |
| CAT2                                                         | 20                        | 40                          | 20                     | 20                      | -                        | -                      | 100            |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                        | 40                          | 20                     | 20                      | -                        | -                      | 100            |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                        | 40                          | 20                     | 20                      | -                        | -                      | 100            |
| ESE                                                          | 20                        | 40                          | 20                     | 20                      | -                        | -                      | 100            |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                             |                    |
|-----------------|-----------------------------|--------------------|
| <b>22NBS205</b> | <b>PHYSICS OF MATERIALS</b> | <b>SEMESTER II</b> |
|-----------------|-----------------------------|--------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>BS</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <ol style="list-style-type: none"><li>1. To understand the properties of conducting materials</li><li>2. To understand the properties of semiconductors</li><li>3. To understand the properties of magnetic and superconducting materials</li><li>4. To explain the synthesis, characteristics, properties of nanomaterials and their applications</li><li>5. To explain the importance of thin film solar cells and their fabrication techniques</li></ol> |                  |  |
| <b>UNIT– I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>ELECTRONIC MATERIALS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>9 Periods</b> |  |
| Classical Free electron theory of metals – Postulates – Electrical and Thermal conductivity of metals – Derivation of Wiedemann – Franz law – Lorentz number – Drawbacks of Classical theory – Fermi distribution function- Effect of temperature – Density of energy states in metals (derivation) – Carrier concentration in metals- Fermi energy at 0K                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |  |
| <b>UNIT– II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>SEMICONDUCTORS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>9 Periods</b> |  |
| Properties of semiconductors – elemental and compound semiconductors - Direct and indirect band gaps - Intrinsic and extrinsic semiconductors - Fermi level - Carrier concentration in intrinsic semiconductor - Dependence of Fermi level on temperature – Electrical conductivity – band gap determination – extrinsic semiconductors – Carrier concentration in P- type and N-type semiconductors - Dependence of Fermi level on impurity concentration and temperature for P-type and N-type semiconductors-P-N Junction diode-V-I characteristics. |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |  |
| <b>UNIT– III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>MAGNETIC AND SUPERCONDUCTING MATERIALS</b>                                                                                                                                                                                                                                                                                                                                                                                                               | <b>9 Periods</b> |  |
| Origin of magnetic moment - Bohr magneton - Dia, Para, and Ferro magnetic materials - Domain theory of ferromagnetism - Hysteresis - Hard and Soft magnetic materials. Superconductivity - Types of superconductors - BCS theory of superconductivity (qualitative) - properties- -Meissner effect, effect of magnetic field and heavy current- Applications of superconductors: Cryotron, Magnetic levitation                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |  |
| <b>UNIT– IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>NANOMATERIALS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>9 Periods</b> |  |
| Nanomaterials – Basic principles of nanomaterials-Quantum wells, Quantum wires and Quantum dots – Lithography- Photoresist spinner-positive and negative photoresists- Fabrication methods of nanomaterials– Top down and Bottom-up Approach – Ball Milling – Chemical vapour deposition – Properties and applications of Nanomaterials-Carbon nanotubes (CNT)-structure-properties-applications-MEMS and Nano MEMS                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |  |
| <b>UNIT– V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>THIN FILM PHYSICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>9 Periods</b> |  |
| Basic of thin film growth process- epitaxy – thin film structure-substrate effect-epitaxial deposition-Importance of thin film solar cells- amorphous, polycrystalline and crystalline silicon based solar cells-Cadmium telluride-Copper indium gallium selenide- Gallium arsenide-Fabrication of thin films-sol-gel synthesis -spin coating- chemical vapor deposition- RF sputtering deposition- Application of thin films in optoelectronic devices.                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                  |  |

**TEXT BOOK:**

|   |                                                                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>P.K.Palanisamy “Engineering Physics-II”, Scitech Publications(India)pvt.Ltd, 2015</i>                                                                                                              |
| 2 | <i>Jianguo Zhu, Xiaohong Zhu, Hong Liu and Jie Xing, “Thin film Physics and Devices, Fundamental Mechanism, Materials and Applications for Thin films”, World Scientific Publishing Co. Pvt. Ltd.</i> |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

REFERENCES:

|   |                                                                                                                                                            |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Dr.V.Rajendran, " <b>Material Science</b> ", Tata McGraw-Hill Publications, NewDelhi, 2011.                                                                |
| 2 | William D Callister Jr., and David G. Rethwisch , " <b>Materials science &amp; Engineering : An introduction</b> ", Wiley, 9 <sup>th</sup> edition , 2014. |
| 3 | S. M. Sze " <b>Semiconductor Devices: Physics and Technology</b> ", Wiley, 3 <sup>rd</sup> edition, 2015.                                                  |
| 4 | A.Goswami, " <b>Thin film Fundamentals</b> ", New Age International Publishers, Reprint (2013).                                                            |

| COURSE OUTCOMES:                                             |                                                                                     | Bloom's<br>Taxonomy<br>Mapped |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                     |                               |
| CO1                                                          | Explain the properties of conducting materials                                      | K2                            |
| CO2                                                          | Explain the characteristics of semiconducting materials                             | K2                            |
| CO3                                                          | Explain the properties of magnetic and superconducting materials                    | K2                            |
| CO4                                                          | Analyze the synthesis, properties and applications of nanomaterials                 | K4                            |
| CO5                                                          | Apply the importance of thin film based solar cells for optoelectronic applications | K3                            |

| COURSE ARTICULATION MATRIX:               |          |          |          |          |      |      |      |      |      |       |       |       |          |          |       |
|-------------------------------------------|----------|----------|----------|----------|------|------|------|------|------|-------|-------|-------|----------|----------|-------|
| a) CO and PO Mapping:                     |          |          |          |          |      |      |      |      |      |       |       |       |          |          |       |
| COs/POs                                   | PO 1     | PO 2     | PO 3     | PO 4     | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1    | PS O2    | PS O3 |
| CO1                                       | 3        | 2        | -        | -        | -    | -    | -    | -    | -    | -     | -     | -     | 1        | 1        | -     |
| CO2                                       | 3        | 2        | -        | -        | -    | -    | -    | -    | -    | -     | -     | -     | 1        | 1        | -     |
| CO3                                       | 3        | 2        | 1        | -        | -    | -    | -    | -    | -    | -     | -     | -     | 1        | 1        | -     |
| CO4                                       | 3        | 2        | 1        | 1        | -    | -    | -    | -    | -    | -     | -     | -     | 1        | 1        | -     |
| CO5                                       | 3        | 2        | 1        | 1        | -    | -    | -    | -    | -    | -     | -     | -     | 1        | 1        | -     |
| <b>22NBS205</b>                           | <b>3</b> | <b>2</b> | <b>1</b> | <b>1</b> | -    | -    | -    | -    | -    | -     | -     | -     | <b>1</b> | <b>1</b> | -     |
| 1 – Slight, 2 – Moderate, 3 – Substantial |          |          |          |          |      |      |      |      |      |       |       |       |          |          |       |

| b) CO and Key Performance Indicators Mapping: |                                                                               |
|-----------------------------------------------|-------------------------------------------------------------------------------|
| CO1                                           | 1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.3,2.4.1,2.4.2,2.4.3,2.4.4                   |
| CO2                                           | 1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.3,2.4.1,2.4.2,2.4.3,2.4.4                   |
| CO3                                           | 1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.3,2.4.1,2.4.2,2.4.3,2.4.4,3.1.5             |
| CO4                                           | 1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.3,2.2.3,2.4.1,2.4.2,2.4.3,2.4.4,3.1.5,4.1.2 |
| CO5                                           | 1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.3,2.2.3,2.4.1,2.4.2,2.4.3,2.4.4,3.1.5,4.1.2 |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>ASSESSMENT PATTERN – THEORY:</b>                          |                           |                             |                        |                         |                          |                        |                |
|--------------------------------------------------------------|---------------------------|-----------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------|
| <b>Test / Bloom's Category*</b>                              | <b>Remembering (K1) %</b> | <b>Understanding (K2) %</b> | <b>Applying (K3) %</b> | <b>Analyzing (K4) %</b> | <b>Evaluating (K5) %</b> | <b>Creating (K6) %</b> | <b>Total %</b> |
| CAT1                                                         | 25                        | 30                          | 25                     | 20                      | -                        | -                      | 100            |
| CAT2                                                         | 25                        | 30                          | 25                     | 20                      | -                        | -                      | 100            |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 40                        | 40                          | 20                     | -                       | -                        | -                      | 100            |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 40                        | 40                          | 20                     | -                       | -                        | -                      | 100            |
| ESE                                                          | 25                        | 20                          | 25                     | 20                      | -                        | -                      | 100            |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                          |                    |
|-----------------|--------------------------------------------------------------------------|--------------------|
| <b>22NBS206</b> | <b>APPLIED CHEMISTRY</b><br>(Common to EEE, ECE, EIE, CSE & IT Branches) | <b>SEMESTER II</b> |
|-----------------|--------------------------------------------------------------------------|--------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | BS       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                               |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1. To know about the second law of thermodynamics and its various functions.                                                  |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2. To understand the concept of electrochemistry, primary, secondary batteries, construction and its uses.                    |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3. To understand the basic principles of corrosion, mechanism and its protection methods.                                     |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 4. To acquire basic knowledge about the nanoparticles, its preparations, properties, types and applications in various field. |                  |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 5. To impart the knowledge of preparations of single crystal, wafer preparation, P-N junction formation by various methods.   |                  |
| <b>UNIT-I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>CHEMICAL THERMODYNAMICS</b>                                                                                                | <b>9 Periods</b> |
| The Second law of thermodynamics-Concepts of entropy, Work and free energy functions - Maxwell's relationships for reversible and irreversible process - Gibbs Helmholtz equation – Partial molar free energy-Chemical potential-Gibb's Duhem Equation, Clausius - Clapeyron equation.                                                                                                                                                                               |                                                                                                                               |                  |
| <b>UNIT- II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>ELECTRO CHEMISTRY AND STORAGE DEVICES</b>                                                                                  | <b>9 Periods</b> |
| Cells–Electro chemical cell and electrolytic cell – electrodes– electrode potentials – standard oxidation and reduction potentials-Hydrogen and Calomel electrodes- EMF series and its significance. Batteries - Types of batteries- Primary - Zn/MnO <sub>2</sub> and Li/SOCl <sub>2</sub> - Construction, working and applications. Secondary batteries- Lead acid battery and lithium-ion battery – Li-TiS <sub>2</sub> - Construction, working and Applications. |                                                                                                                               |                  |
| <b>UNIT- III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>CORROSION</b>                                                                                                              | <b>9 Periods</b> |
| Corrosion-Definition -Classifications: Chemical Corrosion and Electro chemical corrosion mechanism-Pilling Bedworth rule–Galvanic series and its importance- preventing methods-Cathodic protection (sacrificial anode and impressed current conversion method). Protective Coatings- Inorganic coating-surface preparation-Electro plating method applied to Cr and Ni, Organic coating-paints - constituents and its functions.                                    |                                                                                                                               |                  |
| <b>UNIT- IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>NANO MATERIALS</b>                                                                                                         | <b>9 Periods</b> |
| Nanomaterials and bulk materials; Size-dependent properties (Optical, Electrical and Mechanical); Types of nanomaterials: Definition- properties and uses of nanoparticle, nanorod and nanotube. Preparation of nanomaterials: chemical vapour deposition, electrochemical deposition. Applications of nanomaterials in medicine and electronics.                                                                                                                    |                                                                                                                               |                  |
| <b>UNIT- V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>FABRICATION</b>                                                                                                            | <b>9 Periods</b> |
| Silicon for IC chips - single crystal – preparation by Czochralski and float zone processes- wafer preparation, P-N junction formation – Ion implantation. Diffusion and epitaxial growth techniques - Insulator layer by oxidation- Printing of circuits by photolithography – masking and electron beam methods- etching by chemical and electrochemical methods.                                                                                                  |                                                                                                                               |                  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                               |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                               |                  |

**TEXT BOOK:**

|   |                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Jain. P.C. and Monica Jain, " <b>Engineering Chemistry</b> ", Dhanpat Rai Publications Pvt Ltd, New Delhi, 16 <sup>th</sup> Edition, 2017. |
| 2 | S.S. Dara, " <b>A text book of Engineering Chemistry</b> ", S. Chand Publishing, 12 <sup>th</sup> Edition, 2018.                           |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

**REFERENCES:**

|   |                                                                                                                                                                                                   |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Dara. S.S, Umarae, " <b>Text book of Engineering Chemistry</b> ", S. Chand Publications, 2013.                                                                                                    |
| 2 | M.S.Tyagi, " <b>Introduction to semiconductor materials and devices</b> ", Wiley India, 2012.                                                                                                     |
| 3 | B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, " <b>Textbook of nanoscience and nanotechnology</b> ", Universities Press-IIM Series in Metallurgy and Materials Science, 2018. |
| 4 | B.R Puri, L.R Sharma & M. S. Pathania, " <b>Principles of Physical Chemistry</b> ".S , Nagin Chand and Co., 2017.                                                                                 |

**COURSE OUTCOMES:**

Upon completion of the course, the students will be able to:

| COURSE OUTCOMES: |                                                                                                                                 | Bloom's Taxonomy Mapped |
|------------------|---------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| CO1              | Analyze the applications of thermodynamics and its various functions.                                                           | K3                      |
| CO2              | Implement the new ideas related to batteries which find uses in the society including engineering fields.                       | K3                      |
| CO3              | Identify the corrosion mechanisms and its controlling methods.                                                                  | K3                      |
| CO4              | Applying the concepts of nanoscience and nanotechnology in the synthesis of nanomaterials for engineering applications.         | K3                      |
| CO5              | Construct the silicon chips and their fabrication methods and to apply in preparation of electrical and electronic instruments. | K3                      |

**COURSE ARTICULATION MATRIX:**

**a) CO and PO Mapping:**

| COs/POs         | PO 1     | PO 2     | PO 3     | PO 4     | PO 5     | PO 6     | PO 7     | PO 8     | PO 9     | PO 10    | PO 11    | PO 12    | PS O1    | PS O2    | PS O3    |
|-----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO1             | 2        | 1        | 1        | -        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 1        |
| CO2             | 2        | 1        | 1        | -        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 1        |
| CO3             | 1        | 1        | 1        | 1        | 1        | 2        | 1        | -        | -        | -        | -        | -        | 1        | 1        | 1        |
| CO4             | 1        | 1        | 1        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 1        |
| CO5             | 1        | 1        | 1        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 2        | 1        | 1        |
| <b>22NBS206</b> | <b>2</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>2</b> | <b>1</b> | <b>1</b> |

1 – Slight, 2 – Moderate, 3 – Substantial

**b) CO and Key Performance Indicators Mapping:**

|     |                                                               |
|-----|---------------------------------------------------------------|
| CO1 | 1.1.1, 1.2.1, 2.1.2, 2.1.3, 2.3.1, 3.2.2, 5.1.1               |
| CO2 | 1.1.2, 1.2.1, 2.3.1, 3.2.2, 5.1.1                             |
| CO3 | 1.2.1, 2.3.1, 3.2.2, 4.1.1, 4.3.1, 5.1.1, 6.1.1, 7.1.1        |
| CO4 | 1.2.1, 2.2.2, 2.3.1, 3.2.2, 4.1.1, 4.3.1, 5.1.1, 5.1.2, 7.1.1 |
| CO5 | 1.2.1, 2.3.1, 3.2.2, 4.1.2, 5.1.1                             |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| <b>ASSESSMENT PATTERN – THEORY :</b>                         |                           |                             |                        |                         |                          |                        |                |
|--------------------------------------------------------------|---------------------------|-----------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------|
| <b>Test / Bloom's Category*</b>                              | <b>Remembering (K1) %</b> | <b>Understanding (K2) %</b> | <b>Applying (K3) %</b> | <b>Analyzing (K4) %</b> | <b>Evaluating (K5) %</b> | <b>Creating (K6) %</b> | <b>Total %</b> |
| CAT1                                                         | 30                        | 40                          | 20                     | 10                      | -                        | -                      | 100            |
| CAT2                                                         | 30                        | 40                          | 20                     | 10                      | -                        | -                      | 100            |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                        | 40                          | 20                     | 10                      | -                        | -                      | 100            |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                        | 40                          | 20                     | 10                      | -                        | -                      | 100            |
| ESE                                                          | 30                        | 40                          | 20                     | 10                      | -                        | -                      | 100            |



## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                                      |                    |
|-----------------|--------------------------------------------------------------------------------------|--------------------|
| <b>22NES204</b> | <b>BASICS OF CIVIL AND MECHANICAL ENGINEERING</b><br>(Common all EEE & EIE Branches) | <b>SEMESTER II</b> |
|-----------------|--------------------------------------------------------------------------------------|--------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>ES</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives</b> | <ol style="list-style-type: none"> <li>1. To impart basic knowledge on building materials and construction practices.</li> <li>2. To know the basics of Civil Engineering infrastructure development works.</li> <li>3. To impart basic knowledge on Basic mechanical devices, Refrigeration and Air-conditioning systems.</li> <li>4. To provide an insights to the basic conventional and non-conventional machining techniques.</li> </ol> |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**PART – A CIVIL ENGINEERING**

|                |                                            |                  |
|----------------|--------------------------------------------|------------------|
| <b>UNIT– I</b> | <b>BUILDING MATERIALS AND CONSTRUCTION</b> | <b>8 Periods</b> |
|----------------|--------------------------------------------|------------------|

Properties and applications: Stone, Bricks, Cement, Concrete, Steel, Timber – Basic surveying methods and surveying instruments – Building elements and its construction: Foundation, Flooring, Masonry and Roofing.

|                 |                                              |                  |
|-----------------|----------------------------------------------|------------------|
| <b>UNIT– II</b> | <b>WATER SUPPLY AND SANITARY ENGINEERING</b> | <b>7 Periods</b> |
|-----------------|----------------------------------------------|------------------|

Sources of water – Hydrological cycle – Quality of water – Distribution of water – Methods of rain water harvesting. Sanitary Engineering – Systems of Sewerage – Collection, disposal of sewage.

|                  |                                                  |                  |
|------------------|--------------------------------------------------|------------------|
| <b>UNIT– III</b> | <b>IRRIGATION AND TRANSPORTATION ENGINEERING</b> | <b>7 Periods</b> |
|------------------|--------------------------------------------------|------------------|

Irrigation methods - Hydraulic Structures: Dams – Parts of the dam and their functions, Canals and Diversion headworks.

Modes of transportation – Highways – Classification and geometrical features, components of track and its functions.

**PART – B MECHANICAL ENGINEERING**

|                 |                                     |                  |
|-----------------|-------------------------------------|------------------|
| <b>UNIT– IV</b> | <b>BASICS OF MECHANICAL DEVICES</b> | <b>8 Periods</b> |
|-----------------|-------------------------------------|------------------|

Internal Combustion (IC) engines – Otto and Diesel Cycles - Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines - Working principle of Boilers, Turbines, Reciprocating Pumps and Centrifugal Pumps - Concept of hybrid engines - Industrial safety practices and protective devices.

|                |                                                  |                  |
|----------------|--------------------------------------------------|------------------|
| <b>UNIT– V</b> | <b>REFRIGERATION AND AIR CONDITIONING SYSTEM</b> | <b>7 Periods</b> |
|----------------|--------------------------------------------------|------------------|

Terminology of Refrigeration and Air Conditioning - Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner - Properties of air-water mixture - Concepts of psychometric and its process.

|                 |                                |                  |
|-----------------|--------------------------------|------------------|
| <b>UNIT– VI</b> | <b>METAL CUTTING PROCESSES</b> | <b>8 Periods</b> |
|-----------------|--------------------------------|------------------|

Lathe components and their functions - Basic operations of Lathe - Introduction to CNC Lathe - Types of Drilling machine - Main parts and functions - Shaper and Planer machines - Components and functions - Non-conventional machining techniques - Basic principles and operations of Electrochemical Machining (ECM), Electrical Discharge Machining (EDM) and Laser Beam Machining (LBM).

**Contact Periods:**

**Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods**

**TEXT BOOK:**

|   |                                                                                                                 |
|---|-----------------------------------------------------------------------------------------------------------------|
| 1 | Shanmugam G., Palanichamy M S., “ <b>Basic Civil and Mechanical Engineering</b> ”, McGraw Hill Education, 2018. |
| 2 | Ramamrutham ., “ <b>Basic Civil Engineering</b> ”, Dhanpat Rai Publishing Co.(P) Ltd. 2013                      |
| 3 | Venugopal K, Prabu Raja V., “ <b>Basic Mechanical Engineering</b> ”, Anuradha Publications, 2014.               |
| 4 | Domkundwa S, Kothandaraman, C.P., Domkundwar A, “ <b>Thermal Engineering</b> ”, Dhanpat Rai                     |

|   |                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------|
|   | &Co.Publishers, New Delhi, 2013.                                                                                                           |
| 5 | SeropeKalpakjian., Steven R Schmid., “ <b>Manufacturing Engineering and Technology</b> ”, Pearson Education, 7 <sup>th</sup> Edition, 2018 |

|   |                                                                                                                                                                        |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>P.C.Varghese “Building Materials” PHI Learning pvt. Ltd, New Delhi, 2015.</i>                                                                                       |
| 2 | <i>Bhavikatti,S.S., “Basic Civil Engineering”, New Age International, 2019</i>                                                                                         |
| 3 | <i>Ganesan V., “Internal Combustion Engines”, Tata McGraw Hill, New Delhi, 2012.</i>                                                                                   |
| 4 | <i>Ananthanarayanan, P.N., “Basic Refrigeration and Air Conditioning”, McGraw-Hill Education (India), 2013.</i>                                                        |
| 5 | <i>Hajrachoudhury A K.,Hajrachoudhury S K.,“Elements of Workshop Technology Vol-I: Manufacturing Processes”, Media Promoters and Publishers Pvt Ltd, Mumbai, 2014.</i> |
| 6 | <i>Sharma P C., “A Textbook of Production Technology (Manufacturing Processes)”, S.Chand&amp; Company Ltd., New Delhi, 2015.</i>                                       |

| <b>COURSE OUTCOMES:</b>                                      |                                                                                                                          | <b>Bloom's Taxonomy Mapped</b> |
|--------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                                          |                                |
| CO1                                                          | Know the properties and uses of building materials and types of foundation for green building.                           | K1                             |
| CO2                                                          | Identify various sources of water, rain water harvesting and sewage disposal methods.                                    | K1                             |
| CO3                                                          | Indicate the importance of transportation and irrigation practices.                                                      | K2                             |
| CO4                                                          | Apply the knowledge on Basic mechanical devices and Refrigeration and Air-conditioning in their field of specialization. | K3                             |
| CO5                                                          | Apply the concept of different metal cutting techniques in their applications.                                           | K3                             |

### a) CO and PO Mapping:

[illegible]

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| <b>ASSESSMENT PATTERN – THEORY :</b>                         |                           |                             |                        |                         |                          |                        |                |
|--------------------------------------------------------------|---------------------------|-----------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------|
| <b>Test / Bloom's Category*</b>                              | <b>Remembering (K1) %</b> | <b>Understanding (K2) %</b> | <b>Applying (K3) %</b> | <b>Analyzing (K4) %</b> | <b>Evaluating (K5) %</b> | <b>Creating (K6) %</b> | <b>Total %</b> |
| CAT1                                                         | 40                        | 40                          | 20                     | -                       | -                        | -                      | 100            |
| CAT2                                                         | 40                        | 40                          | 20                     | -                       | -                        | -                      | 100            |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 40                        | 40                          | 20                     | -                       | -                        | -                      | 100            |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 40                        | 40                          | 20                     | -                       | -                        | -                      | 100            |
| ESE                                                          | 40                        | 40                          | 20                     | -                       | -                        | -                      | 100            |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                      |                                                         |                    |          |          |            |
|----------------------|---------------------------------------------------------|--------------------|----------|----------|------------|
| <b>22NBS2Z7</b>      | <b>CHEMISTRY LABORATORY</b><br>(Common to all Branches) | <b>SEMESTER II</b> |          |          |            |
| <b>PREREQUISITES</b> | <b>CATEGORY</b>                                         | <b>L</b>           | <b>T</b> | <b>P</b> | <b>C</b>   |
| <b>NIL</b>           | <b>BS</b>                                               | <b>0</b>           | <b>0</b> | <b>3</b> | <b>1.5</b> |

|                                                                                                      |                                                                                                                                   |
|------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives</b>                                                                             | To inculcate the practical applications of Chemistry to students and make them apply in the fields of engineering and technology. |
| <b>S. No.</b>                                                                                        | <b>LIST OF EXPERIMENTS:</b>                                                                                                       |
| 1.                                                                                                   | Estimation of hardness by EDTA method.                                                                                            |
| 2.                                                                                                   | Conductometric titration of mixture of strong acid and weak acid using strong base.                                               |
| 3.                                                                                                   | Estimation of chloride by Argentometric method.                                                                                   |
| 4.                                                                                                   | Potentiometric titration of ferrous iron by dichromate.                                                                           |
| 5.                                                                                                   | Determination of Saponification value of an oil.                                                                                  |
| 6.                                                                                                   | Estimation of Iron by Spectrophotometry.                                                                                          |
| 7.                                                                                                   | Estimation of Dissolved Oxygen.                                                                                                   |
| 8.                                                                                                   | Estimation of HCl by pH titration.                                                                                                |
| 9.                                                                                                   | Estimation of Copper in brass sample.                                                                                             |
| 10.                                                                                                  | Estimation of Manganese in Pyrolusite ore.                                                                                        |
| 11.                                                                                                  | Anodization of aluminium.                                                                                                         |
| 12.                                                                                                  | Determination of corrosion rate and inhibitor efficiency of mild steel in acid media by weight loss method.                       |
| <b>Contact Periods:</b>                                                                              |                                                                                                                                   |
| <b>Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods</b> |                                                                                                                                   |

**REFERENCES:**

|   |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>A.O. Thomas, "Practical Chemistry", Scientific Book Centre, Cannanore, 2006.</i>                                         |
| 2 | <i>Vogel's "Text book of Quantitative Analysis", Jeffery G H, Basset J. Menthom J, Denney R.C., 6th Edition, EBS, 2009.</i> |

|                                                                                           |                                                                                            |                                |
|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------|
| <b>COURSE OUTCOMES:</b><br>Upon the completion of the course, the student will be able to |                                                                                            | <b>Bloom's Taxonomy Mapped</b> |
| CO1                                                                                       | To analyze the quality of water samples with respect to their hardness and DO.             | K3                             |
| CO2                                                                                       | To determine the amount of metal ions through potentiometric and spectroscopic techniques. | K3                             |
| CO3                                                                                       | Infer the strength of an acid, mixtures of acids by pH meter and conductivity cell.        | K3                             |
| CO4                                                                                       | To estimate the chloride, manganese and copper from various samples.                       | K3                             |
| CO5                                                                                       | Interpret the corrosion rate determination and anodizing method.                           | K2                             |

**COURSE ARTICULATION MATRIX:**

**a) CO and PO Mapping:**

| COs/POs         | PO 1     | PO 2     | PO 3     | PO 4     | PO 5     | PO 6     | PO 7     | PO 8     | PO 9     | PO 10    | PO 11    | PO 12    | PS O1    | PS O2    | PS O3    |
|-----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO1             | 2        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | -        |
| CO2             | 2        | 1        | -        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | -        |
| CO3             | 2        | 1        | -        | 1        | -        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | -        |
| CO4             | 2        | 1        | -        | -        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 1        | -        |
| CO5             | 2        | 1        | 1        | 1        | -        | -        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        |
| <b>22NBS2Z7</b> | <b>2</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>1</b> | <b>-</b> |

1 – Slight, 2 – Moderate, 3 – Substantial

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| b) CO and Key Performance Indicators Mapping |                                                  |
|----------------------------------------------|--------------------------------------------------|
| CO1                                          | 1.1.1, 1.2.1, 2.3.1, 3.1.5,                      |
| CO2                                          | 1.1.1, 1.2.1, 1.3.1, 2.1.2,                      |
| CO3                                          | 1.1.1, 1.2.1, 2.1.3, 4.1.3,                      |
| CO4                                          | 1.2.1, 1.3.1, 2.3.1,                             |
| CO5                                          | 1.1.1, 1.2.1, 1.3.1, 2.3.1, 3.1.5, 4.2.1, 7.1.1, |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                         |                    |
|-----------------|---------------------------------------------------------|--------------------|
| <b>22NES2Z5</b> | <b>ENGINEERING GRAPHICS</b><br>(Common to all Branches) | <b>SEMESTER II</b> |
|-----------------|---------------------------------------------------------|--------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>ES</b>       | <b>1</b> | <b>0</b> | <b>4</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                          |                     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1. To understand the geometrical constructions.<br>2. To study the various types of projections.<br>3. To identify different section of solids.<br>4. To perform the development of surfaces and view of solids.<br>5. To familiarize with CAD packages. |                     |
| <b>UNIT– I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>GEOMETRICAL CONSTRUCTIONS AND PLANE CURVES</b>                                                                                                                                                                                                        | <b>3+12 Periods</b> |
| Principles of Engineering Graphics and their significance - Basic geometrical constructions. Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Drawing of tangents and normal to the above curves.                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                          |                     |
| <b>UNIT– II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>ORTHOGRAPHIC PROJECTIONS</b>                                                                                                                                                                                                                          | <b>3+12 Periods</b> |
| Introduction to Orthographic Projection - Conversion of pictorial views to orthographic views. Projection of points - Projection of straight lines with traces - Projection of planes (polygonal and circular surfaces) inclined to both the principal planes.                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                          |                     |
| <b>UNIT– III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>PROJECTION AND SECTION OF SOLIDS</b>                                                                                                                                                                                                                  | <b>3+12 Periods</b> |
| Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids, when the axis is inclined to both the principal planes by rotating object method. Sectioning of prisms, pyramids, cylinder and cone in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section.                                                                                |                                                                                                                                                                                                                                                          |                     |
| <b>UNIT– IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS</b>                                                                                                                                                                                                 | <b>3+12 Periods</b> |
| Development of lateral surfaces of simple and sectioned solids – prisms, pyramids, cylinder and cone. Principles of isometric projection – isometric scale – isometric projections of simple solids and truncated solids - prisms, pyramids, cylinder, cone- combination of two solid objects in simple vertical positions.                                                                                                                                                    |                                                                                                                                                                                                                                                          |                     |
| <b>UNIT– V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>COMPUTER AIDED DRAFTING</b>                                                                                                                                                                                                                           | <b>3+12 Periods</b> |
| Introduction to computer aided drafting package to make 2D Drawings. Object Construction: Page layout – Layers and line types – Creating, editing and selecting the geometric objects. Mechanics: Viewing, annotating, hatching and dimensioning the drawing – Creating blocks and attributes. Drafting: Create 2D drawing. A number of chosen problems will be solved to illustrate the concepts clearly.<br>(Demonstration purpose only, not to be included in examination). |                                                                                                                                                                                                                                                          |                     |
| <b>Contact Periods:</b><br><b>Lecture: 15 Periods      Tutorial: 0 Periods      Practical: 60 Periods      Total: 75 Periods</b>                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                          |                     |

**TEXT BOOK:**

|   |                                                                                                      |
|---|------------------------------------------------------------------------------------------------------|
| 1 | <i>K.Venugopal, “Engineering Graphics”, New Age International (P) Limited, 2016.</i>                 |
| 2 | <i>K.V.Natarajan, “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2016.</i> |

**REFERENCES:**

|   |                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>K.L.Narayana and P.Kannaiah, “Text book on Engineering Drawing”, 2<sup>nd</sup> Edition, SciTech Publications (India) Pvt. Ltd, Chennai, 2009.</i> |
| 2 | <i>N.S.Parthasarathy and Vela Murali, “Engineering Graphics”, Oxford University Press, New Delhi, 2015.</i>                                           |
| 3 | <i>K.R.Gopalakrishna, “Engineering Drawing” (Vol. I&amp;II combined), Subhas Publications,</i>                                                        |

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|   |                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------|
|   | Bangalore, 2014.                                                                                                                           |
| 4 | Basant Agarwal and C.M.Agarwal, “Engineering Drawing”, Tata McGraw Hill Publishers, New Delhi, 2013.                                       |
| 5 | Kevin Lang and Alan J.Kalameja, “AutoCAD 2012 Tutor for Engineering Graphics”, Cengage Learning Publishers, 1 <sup>st</sup> Edition, 2011. |

| COURSE OUTCOMES:                                             |                                                                 | Bloom's<br>Taxonomy<br>Mapped |
|--------------------------------------------------------------|-----------------------------------------------------------------|-------------------------------|
| Upon completion of the course, the students will be able to: |                                                                 |                               |
| CO1                                                          | Acquire on representing solids as per international standards.  | K3                            |
| CO2                                                          | Impart knowledge on different types of projections.             | K3                            |
| CO3                                                          | Generate and interrupt the true shape of section.               | K3                            |
| CO4                                                          | Develop the various surfaces according to the standards.        | K3                            |
| CO5                                                          | Know the concept of computers in drafting engineering diagrams. | K6                            |

| COURSE ARTICULATION MATRIX:               |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| a) CO and PO Mapping:                     |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| COs/POs                                   | PO 1     | PO 2     | PO 3     | PO 4     | PO 5     | PO 6     | PO 7     | PO 8     | PO 9     | PO 10    | PO 11    | PO 12    | PS O1    | PS O2    | PS O3    |
| CO1                                       | 3        | 1        | 1        | 1        | 1        | 2        | -        | 3        | 1        | 3        | 1        | 3        | 1        | 1        | 2        |
| CO2                                       | 3        | 1        | 1        | 1        | 1        | 2        | -        | 3        | 1        | 3        | 1        | 3        | 1        | 1        | 2        |
| CO3                                       | 3        | 1        | 1        | 1        | 1        | 2        | -        | 3        | 1        | 3        | 1        | 3        | 1        | 1        | 2        |
| CO4                                       | 3        | 1        | 1        | 1        | 1        | 2        | -        | 3        | 1        | 3        | 1        | 3        | 1        | 1        | 2        |
| CO5                                       | 3        | 1        | 1        | 1        | 1        | 2        | -        | 3        | 1        | 3        | 1        | 3        | 1        | 1        | 2        |
| <b>22NES2Z5</b>                           | <b>3</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>2</b> | <b>-</b> | <b>3</b> | <b>1</b> | <b>3</b> | <b>1</b> | <b>3</b> | <b>1</b> | <b>1</b> | <b>2</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

| b) CO and Key Performance Indicators Mapping : |                                                                                                                                                                                                                       |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                            | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |
| CO2                                            | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2         |
| CO3                                            | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |
| CO4                                            | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |
| CO5                                            | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.3, 2.4.2, 3.1.2, 3.1.4, 3.2.1, 4.3.3, 5.1.1, 6.2.1, 8.1.1, 8.2.1, 8.2.2, 9.2.1, 9.2.4, 10.1.1, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.2.1, 12.2.2, 12.3.1, 12.3.2         |

|          |                                    |              |
|----------|------------------------------------|--------------|
| 22NES306 | THERMODYNAMICS AND FLUID MECHANICS | SEMESTER III |
|----------|------------------------------------|--------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | ES       | 4 | 0 | 0 | 4 |

## A) THERMODYNAMICS

|                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                 |                   |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                     | To expose thermodynamic concepts, processes and cycles for analyzing the thermodynamic systems. |                   |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                             | <b>CONCEPT OF THERMODYNAMICS</b>                                                                | <b>10 Periods</b> |  |
| Basic definitions - Microscopic and Macroscopic approach - Types of systems - State, Process, Path and Cycle - Quasi-static process - Thermodynamic Properties - Zeroth law - Thermodynamic concept of energy - Heat and work - First law of thermodynamics - PMM 1 - Thermodynamic process of closed and open systems – Steady Flow Energy Equation.                                                                       |                                                                                                 |                   |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                            | <b>SECOND LAW OF THERMODYNAMICS AND ENTROPY</b>                                                 | <b>10 Periods</b> |  |
| Limitations of First law -Thermal energy reservoirs – Kelvin, Plank and Clausius statements - PMM 2 - Heat engines - Refrigerators and Heat pumps - efficiency and COP - Carnot cycle - Entropy - Clausius Inequality - principle of increase in entropy - Second law efficiency - Exergy analysis of closed and open system - Thermodynamic relations.                                                                     |                                                                                                 |                   |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                           | <b>THERMAL SYSTEMS AND COMPONENTS</b>                                                           | <b>10 Periods</b> |  |
| Boilers – Fire Tube Boilers & Water Tube Boilers, Boiler accessories and components. Turbines – Impulse Turbine and Reaction Turbine, Velocity Triangles, Compounding of Turbines. Air Compressor - Classification and comparison, working principle, work of compression, with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency. Multistage air compressor with Intercooling. |                                                                                                 |                   |  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                 |                   |  |
| <b>Lecture: 30 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 30 Periods</b>                                                                                                                                                                                                                                                                                                                        |                                                                                                 |                   |  |

## TEXT BOOKS:

|   |                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------|
| 1 | Nag. P.K., " <b>Engineering Thermodynamics</b> ", Tata McGraw Hill Company, 5th Edition, 2013.               |
| 2 | Maresh M Rathore., " <b>Thermal Engineering</b> ", TATA McGraw Hill Education, 1 <sup>st</sup> Edition, 2010 |

## REFERENCES:

|   |                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------|
| 1 | Kothandaraman C.P., " <b>Thermal Engineering</b> ", Dhanpat Rai & Sons, 1998.                                 |
| 2 | Yunus A Cengel, " <b>Thermodynamics</b> ", Tata McGraw Hill Company, 8 <sup>th</sup> Edition, 2014            |
| 3 | R.K. Rajput " <b>Engineering Thermodynamics</b> ", Laxmi Publications (P) Ltd, 5 <sup>th</sup> Edition, 2016. |

| COURSE OUTCOMES                                             |                                               | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|-----------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                               |                         |
| CO1                                                         | Acquire knowledge on Thermodynamic laws       | K2                      |
| CO2                                                         | Analyze the principles of entropy generation. | K4                      |
| CO3                                                         | Apply the concepts on thermodynamic systems.  | K2                      |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                         |          |          |          |     |     |     |     |     |      |      |      |      |          |      |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------|----------|----------|-----|-----|-----|-----|-----|------|------|------|------|----------|------|
| COs/POs                                             | PO1                                                                                                     | PO2      | PO3      | PO4      | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2     | PSO3 |
| CO1                                                 | 3                                                                                                       | 3        | 1        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | -    | 1        | -    |
| CO2                                                 | 3                                                                                                       | 3        | 1        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | -    | 1        | -    |
| CO3                                                 | 3                                                                                                       | 2        | 1        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | -    | 1        | -    |
| <b>22NES306 (A)</b>                                 | <b>3</b>                                                                                                | <b>3</b> | <b>1</b> | <b>1</b> | -   | -   | -   | -   | -   | -    | -    | -    | -    | <b>1</b> | -    |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                         |          |          |          |     |     |     |     |     |      |      |      |      |          |      |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                         |          |          |          |     |     |     |     |     |      |      |      |      |          |      |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 3.1.4, 4.1.1 |          |          |          |     |     |     |     |     |      |      |      |      |          |      |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 3.1.4, 4.1.1 |          |          |          |     |     |     |     |     |      |      |      |      |          |      |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 3.1.4, 4.1.1 |          |          |          |     |     |     |     |     |      |      |      |      |          |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                | 30                   | 40             | 10              | -                 | -               | 100     |
| CAT2                                                         | 20                | 30                   | 40             | 10              | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                 | 30                   | 60             | 10              | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                 | 30                   | 60             | 10              | -                 | -               | 100     |
| ESE                                                          | 20                | 30                   | 40             | 10              | -                 | -               | 100     |

**B) FLUID MECHANICS**

|                                                                                                                                                                                                                                                                                              |                                                                                                      |                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                      | To acquire knowledge on the concepts of fluids, its properties ,flow equation and Hydraulic machines |                   |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                              | <b>FLUID PROPERTIES AND MEASUREMENT</b>                                                              | <b>10 Periods</b> |
| Fluid: Units and dimension – Fluid Properties - Density, Specific weight, Specific gravity, viscosity, compressibility, capillarity, surface tension, vapour pressure. Pressure: Laws of pressure-Types of pressure-Pressure measurement-Manometer.                                          |                                                                                                      |                   |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                             | <b>EQUATIONS OF FLUID FLOW</b>                                                                       | <b>10 Periods</b> |
| Fluid kinetics and kinematics: Types of flow - Types of flow lines - Continuity equation 1D & 3D - Euler's equation - Bernoulli's Equation and its application. Impulse momentum equation (Principle only).                                                                                  |                                                                                                      |                   |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                            | <b>HYDRAULIC MACHINES</b>                                                                            | <b>10 Periods</b> |
| Pumps: Classification, Construction and working principle, performance curve – centrifugal pump and reciprocating pump, submersible pump.<br>Turbines: Classification, Construction and working principle, specific speed, and performance curve – Pelton wheel, Francis and Kaplan turbine. |                                                                                                      |                   |
| <b>Contact Periods:</b><br><b>Lecture: 30 Periods    Tutorial: 0 Periods    Practical: 0 Periods    Total: 30 Periods</b>                                                                                                                                                                    |                                                                                                      |                   |

**TEXT BOOKS:**

|   |                                                                                                                                       |
|---|---------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Rajput.R.K., " <i>A Text Book of Fluid Mechanics and Hydraulic machines</i> ", S. Chand and Company, New Delhi, 2011                  |
| 2 | Kumar.K.L. " <i>Engineering Fluid Mechanics</i> ", Eurasia Publishing House (P) Ltd. New Delhi, 2000                                  |
| 3 | Ramamurtham.S and Narayanan. R. " <i>Fluid Hydraulics and Fluid Machines</i> ", Dhanpat Rai Publishing House (P) Ltd. New Delhi, 2000 |

**REFERENCES:**

|   |                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------|
| 1 | P.N.Modi & S.M. Seth , " <i>Hydraulic &amp; Fluid Mechanics including hydraulic machines</i> ", Standard book 2010. |
| 2 | Natarajan.M.K., " <i>Fluid Machines</i> ", Anuradha Agencies, Vidyal Karuppur, Kumbakonaam, 1995.                   |

| <b>COURSE OUTCOMES</b>                                      |                                                                                  | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                  |                                |
| CO1                                                         | Gain knowledge on fluid properties and pressure measurement.                     | K2                             |
| CO2                                                         | Apply the fluid flow equation for solving fluid flow problems in real situation. | K3                             |
| CO3                                                         | Analyze the performance of various fluid machines                                | K3                             |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                         |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                             | PO1                                                                                                     | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 3                                                                                                       | 2        | 1        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | -        | 1        | -        |
| CO2                                                 | 3                                                                                                       | 2        | 1        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | -        | 1        | -        |
| CO3                                                 | 3                                                                                                       | 2        | 1        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | -        | 1        | -        |
| <b>22NES306(B)</b>                                  | <b>3</b>                                                                                                | <b>2</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>-</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                         |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                         |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                                 | 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                                 | 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                                 | 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 3.1.1, 3.2.1, 3.2.3, 4.1.4, 5.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

**ASSESSMENT PATTERN – THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 40                   | 40             | -               | -                 | -               | 100     |
| CAT2                                                         | 20                | 40                   | 40             | -               | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 40                   | 40             | -               | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 40                   | 40             | -               | -                 | -               | 100     |
| ESE                                                          | 20                | 40                   | 40             | -               | -                 | -               | 100     |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|          |                                  |              |
|----------|----------------------------------|--------------|
| 22NPC301 | ELECTRICAL CIRCUITS AND NETWORKS | SEMESTER III |
|----------|----------------------------------|--------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PC       | 3 | 1 | 0 | 4 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                              |                     |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                     | To teach the fundamental concepts of D.C and A.C circuits, coupled and polyphase circuits, two port networks and impart the methods of analysis of linear electric circuits. |                     |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>DC CIRCUITS</b>                                                                                                                                                           | <b>9 +3 Periods</b> |  |
| Basic concepts – Resistors, Inductors, Capacitors – Voltage and Current Sources – Ohm’s law – Kirchhoff’s Laws – Voltage Division and Current Division– Star/Delta Conversion - Source Transformations. Steady state Analysis: Nodal Analysis, Mesh Analysis, Superposition Theorem, Thevenin’s Theorem, Norton’s Theorem, Maximum Power Transfer Theorem, Compensation Theorem, Reciprocity Theorem, Millman’s theorem, Telegen’s Theorem. |                                                                                                                                                                              |                     |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>TRANSIENT ANALYSIS OF CIRCUITS</b>                                                                                                                                        | <b>9 +3 Periods</b> |  |
| Source-Free RC, RL, RLC Circuits – Standard test inputs – Response of RC, RL and RLC Circuits for step and sinusoidal excitation.                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                              |                     |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>AC CIRCUITS</b>                                                                                                                                                           | <b>9 +3 Periods</b> |  |
| Sinusoids– Phasors – Phasor Relationship of Circuit Elements - Impedance and Admittance–Sinusoidal Steady-State Analysis: Nodal Analysis, Mesh Analysis, Superposition Theorem, Thevenin’s Theorem, Norton’s Theorem. Power Analysis – Instantaneous and Average Power– Complex Power - Power Factor and Power Factor Correction.                                                                                                           |                                                                                                                                                                              |                     |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>RESONANCE AND COUPLED CIRCUITS</b>                                                                                                                                        | <b>9 +3 Periods</b> |  |
| Series and Parallel Resonant Circuits –Half power frequencies - Bandwidth – Quality factor. Coupled circuits-Self and Mutual inductance - Dot convention - Coefficient of coupling – Series and parallel connection of coupled coils – Tuned circuits – Ideal Transformer.                                                                                                                                                                  |                                                                                                                                                                              |                     |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>POLYPHASE CIRCUITS AND TWO PORT NETWORKS</b>                                                                                                                              | <b>9 +3 Periods</b> |  |
| Polyphase circuits – Line voltage - Phase voltage – Phasor diagram – Balanced and Unbalanced Loads – Analysis using Star and Delta. Two-Port Networks – Z and Y Parameters –Transmission Parameters – h and g parameters – Inter-connection of Two-Port Networks – T and $\pi$ representation - Lattice Networks.                                                                                                                           |                                                                                                                                                                              |                     |  |
| <b>Contact Periods: 60 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                              |                     |  |
| <b>Lecture: 45 Periods      Tutorial: 15 Periods      Practical: 0 Periods      Total: 60 Periods</b>                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                              |                     |  |

## TEXT BOOKS:

|   |                                                                                                                                      |
|---|--------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Charles K. Alexander, Matthew N.O. Sadiku, " <b>Fundamentals of Electric Circuits</b> ", McGraw-Hill, Seventh Edition, 2021.         |
| 2 | A Sudhakar and Shyammohan S. Palli, " <b>Circuits and Networks Analysis and Synthesis</b> ", Tata McGraw- Hill, Fifth Edition, 2015. |

## REFERENCES:

|   |                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Robert .L Boylsted, " <b>Introductory Circuit Analysis</b> ", Pearson Education, Thirteenth Edition, 2016.                                 |
| 2 | William Hayt, Jack. E. Kemmerley and Steven. M. Durbin, " <b>Engineering circuit Analysis</b> ", Tata McGraw- Hill, Seventh Edition, 2012. |
| 3 | Joseph. A Edminister, Mahmood Navhi, " <b>Electric Circuits</b> ", Schaum's Outline Series, McGraw-Hill, Seventh Edition, 2018.            |
| 4 | Richard. C. Dorf, James. A. Svoboda, " <b>Introduction to Electric Circuits</b> ", John Wiley & Sons, Nineth edition, 2014.                |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                      | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Solve basic DC and AC circuits using network theorems.                               | K4                                     |
| CO2                                                                                   | Analyze the transient behavior of first and second order circuits.                   | K4                                     |
| CO3                                                                                   | Analyze and solve single and three phase circuits                                    | K4                                     |
| CO4                                                                                   | Examine the parameters of resonance and coupled circuits.                            | K4                                     |
| CO5                                                                                   | Simplify complex network into simple network and obtain the parameters of a network. | K4                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                                        | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                                                          | 2   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO2                                                 | 3                                                                                                                                          | 2   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO3                                                 | 3                                                                                                                                          | 2   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO4                                                 | 3                                                                                                                                          | 2   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO5                                                 | 3                                                                                                                                          | 2   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| <b>22NPC301</b>                                     | 3                                                                                                                                          | 2   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6, 4.1.2, 4.1.4, 4.3.1, 4.3.2, 4.3.4        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.4.1, 2.4.2, 2.4.4, 3.1.1, 3.1.6, 4.1.2, 4.1.4, 4.3.1, 4.3.2, 4.3.4 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6, 4.1.4, 4.3.1, 4.3.2, 4.3.4                                    |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6, 4.1.4, 4.3.1, 4.3.2, 4.3.4                                    |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 3.1.1, 3.1.6, 4.1.4, 4.3.1, 4.3.2, 4.3.4                             |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 30                   | 40             | 20             | -                 | -               | 100     |
| CAT2                                                         | 10                | 30                   | 40             | 20             | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                 | 40                   | 40             | 20             | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                 | 40                   | 40             | 20             | -                 | -               | 100     |
| ESE                                                          | 10                | 30                   | 40             | 20             | -                 | -               | 100     |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|          |                    |              |
|----------|--------------------|--------------|
| 22NPC302 | ANALOG ELECTRONICS | SEMESTER III |
|----------|--------------------|--------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PC       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                       |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                             | To impart knowledge on the working of semiconductor devices and the operation of electronic circuits. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                     | <b>PN JUNCTION DEVICES</b>                                                                            | <b>9 Periods</b> |  |
| PN Junction Diode: Structure, Operation, V-I Characteristics, Diffusion and Transition Capacitance - Rectifiers: Half Wave, Full Wave Rectifier - Filters- Regulators - Power Supply- Clipper – Clamper - Zener Diode Characteristics - Zener as Regulator - Schottky Diode - Varactor Diode - Tunnel Diodes – LED - Laser Diodes - Photo Diode - Solar Cell.                       |                                                                                                       |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>BIPOLAR JUNCTION TRANSISTORS</b>                                                                   | <b>9 Periods</b> |  |
| BJT: Structure, Operation of NPN and PNP Transistor, Input and Output Characteristics of CE, CB and CC Configurations - DC Load Line and Operating Point - Need for Biasing - Bias Stabilization - Fixed and Voltage Divider Biasing - Single Stage BJT Amplifiers - AC Analysis of CE and CC Amplifier with Voltage Divider Bias using h-Parameters - Gain and Frequency Response. |                                                                                                       |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                   | <b>FIELD EFFECT TRANSISTORS AND THYRISTORS</b>                                                        | <b>9 Periods</b> |  |
| Structure, Operation and Characteristics of JFET, MOSFET - JFET Biasing: Self and Voltage Divider Biasing - Operation and Applications of UJT, SCR, DIAC and TRIAC                                                                                                                                                                                                                  |                                                                                                       |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER</b>                                               | <b>9 Periods</b> |  |
| Cascade Amplifier - BJT Differential Amplifier: Common Mode and Difference Mode Analysis – Single Tuned Amplifiers – Power Amplifiers: Class A, Class B, Class C and Class AB amplifiers (Qualitative analysis).                                                                                                                                                                    |                                                                                                       |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                     | <b>FEEDBACK AMPLIFIERS AND OSCILLATORS</b>                                                            | <b>9 Periods</b> |  |
| Feedback Concepts - Feedback Topologies: Voltage / Current, Series/ Shunt Feedback - Effect of Negative Feedback in Amplifiers - Positive Feedback – Condition for Oscillations – Types of Oscillators: RC Phase Shift, Wien Bridge, Hartley, Colpitts and Crystal Oscillators - Multivibrator: Monostable, Bistable, Astable Multivibrator.                                        |                                                                                                       |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                  |                                                                                                       |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                |                                                                                                       |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                 |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Thomas L Floyd, " <b>Electronic Devices</b> ", Pearson Education, Tenth Edition, 2017.                                                          |
| 2 | S Salivahanan, N Suresh Kumar, " <b>Electronic Devices and Circuits</b> ", McGraw Hill Education (India) Private Limited, Fourth Edition, 2017. |

**REFERENCES:**

|   |                                                                                                                                    |
|---|------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Robert Boylestad, Louis Nashelsky, " <b>Electronics Devices and Circuit Theory</b> ", Prentice Hall of India, Tenth Edition, 2012. |
| 2 | David A Bell, " <b>Fundamentals of Electronic Devices and Circuits</b> ", Oxford Higher Education, Fifth Edition, 2012.            |
| 3 | Albert Malvino, David J Bates, " <b>Electronic Principles</b> " McGraw Hill, Ninth Edition, 2021.                                  |
| 4 | Allen Mottershead, " <b>Electronic Devices and Circuits: An Introduction</b> ", Prentice Hall of India, Second Edition, 2013.      |
| 5 | Jacob Millman, Christos C Halkias, Satyabrata, " <b>Electronic Devices and Circuits</b> ", McGraw Hill, Fourth Edition, 2015.      |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                              | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Explain the operation and applications of different diodes                   | K2                                     |
| CO2                                                                                   | Describe the working and biasing of transistor and FET                       | K2                                     |
| CO3                                                                                   | Analyze the parameters of amplifier circuits                                 | K4                                     |
| CO4                                                                                   | Compare multistage amplifiers, power amplifiers, and differential amplifiers | K2                                     |
| CO5                                                                                   | Identify the different topologies of feedback amplifiers                     | K2                                     |

## COURSE ARTICULATION MATRIX

### a) CO/PO Mapping

| COs/POs         | PO1      | PO2      | PO3      | PO4      | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1     | PSO2 | PSO3 |
|-----------------|----------|----------|----------|----------|-----|-----|-----|-----|-----|------|------|------|----------|------|------|
| CO1             | 2        | 3        | 1        | -        | -   | -   | -   | -   | -   | -    | -    | -    | 3        | -    | -    |
| CO2             | 2        | 3        | 1        | -        | -   | -   | -   | -   | -   | -    | -    | -    | 3        | -    | -    |
| CO3             | 3        | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 3        | -    | -    |
| CO4             | 2        | 1        | 1        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | 3        | -    | -    |
| CO5             | 2        | 2        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 3        | -    | -    |
| <b>22NPC302</b> | <b>3</b> | <b>3</b> | <b>1</b> | <b>1</b> | -   | -   | -   | -   | -   | -    | -    | -    | <b>3</b> | -    | -    |

1 – Slight, 2 – Moderate, 3 – Substantial

### b) CO and Key Performance Indicators mapping

|     |                                                                                                                                           |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4,3.1.1,3.4.2                                     |
| CO2 | 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4,3.1.1,3.4.1,3.4.2                               |
| CO3 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,4.1.2,4.1.3,4.1.4,4.3.4 |
| CO4 | 1.2.1,1.3.1,1.4.1,2.1.2,2.2.2,2.2.4,3.4.1,4.1.2,4.1.3,4.3.1                                                                               |
| CO5 | 1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.4.2,3.4.1,4.1.2,4.1.3,4.2.1,4.3.1                                                                   |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 70                   | -              | 20              | -                 | -               | 100     |
| CAT2                                                         | -                 | 70                   | 20             | 10              | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                 | 30                   | 50             | 20              | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                 | 30                   | 50             | 20              | -                 | -               | 100     |
| ESE                                                          | 10                | 60                   | 20             | 10              | -                 | -               | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                |                     |
|-----------------|--------------------------------|---------------------|
| <b>22NPC303</b> | <b>SENSORS AND TRANSDUCERS</b> | <b>SEMESTER III</b> |
|-----------------|--------------------------------|---------------------|

|                             |                 |          |          |          |          |
|-----------------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b>        | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>PHYSICS OF MATERIALS</b> | <b>PC</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                      |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                               | To introduce students the principle involved in the operation, selection, calibration of sensors/transducers and signal conditioning circuits used to measure a range of common physical parameters. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>CHARACTERISTICS OF TRANSDUCERS</b>                                                                                                                                                                | <b>9 Periods</b> |  |
| Structure of a general measurement systems and examples – Errors in a measurement system- Classification of errors - Statistical analysis of errors – Sensors and Transducers – Classification of transducers - Static and Dynamic characteristics of Transducers - Mathematical model of a transducer:Zero, First, and Second-order transducers – Selection of transducers – Calibration                                                             |                                                                                                                                                                                                      |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>VARIABLE RESISTANCE TRANSDUCERS</b>                                                                                                                                                               | <b>9 Periods</b> |  |
| Principle, Operation, Characteristics and Applications of Potentiometer – Strain gauge – Load cell – Piezo resistive sensor – Loading effect - Signal conditioners- Application E.g.: Measurement of Force, Torque                                                                                                                                                                                                                                    |                                                                                                                                                                                                      |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>VARIABLE INDUCTANCE AND CAPACITANCE TRANSDUCERS</b>                                                                                                                                               | <b>9 Periods</b> |  |
| Operation, Characteristics and Applications of Transducers working on the principle of: Variation of Self Inductance, Variation of reluctance, Variation of Mutual Inductance, Production of Eddy currents – LVDT and RVDT– Tachogenerators – Capacitive transducers – Inductive and Capacitive Proximity Switches – Application E.g.: Measurement of Pressure, Length, Displacement, Position, Vibration, Thickness, Liquid Level, and Sound, Noise. |                                                                                                                                                                                                      |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>LIGHT, SEISMIC, OCCUPANCY AND MOTION DETECTION</b>                                                                                                                                                | <b>9 Periods</b> |  |
| Operation, Characteristics and Applications of: Photo electric transducers - Piezoelectric transducers, Tactile Sensors, Hall effect sensors - Magnetostrictive sensors – Accelerometers – Gyroscope – Geophones- Ultrasonic sensors- Microwave sensors- Infra-red – PIR sensors.                                                                                                                                                                     |                                                                                                                                                                                                      |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>OTHER TRANSDUCERS</b>                                                                                                                                                                             | <b>9 Periods</b> |  |
| Principle, Operation, Characteristics and Applications of: Digital Transducers - Fiber optic sensor – MEMS – Nano sensors – Smart Sensors - Biochemical Sensors:Enzyme Sensors, Multisensor Arrays, Electronic Noses and Tongues.                                                                                                                                                                                                                     |                                                                                                                                                                                                      |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                      |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                      |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                        |
|---|------------------------------------------------------------------------------------------------------------------------|
| 1 | J. P. Bentley, <i>“Principles of Measurement Systems”</i> , Addison Wesley Longman Ltd., UK, 2010                      |
| 2 | Jacob Fraden, <i>“Handbook of Modern Sensors- Physics, Designs, and Applications”</i> , Springer; 4th ed. 2010 edition |

**REFERENCES:**

|   |                                                                                                                                                                          |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | A.K. Sawhney, Puneet Sawhney, <i>“A Course In Electrical And Electronic Measurements And Instrumentation”</i> , Dhanpat Rai, 2012.                                       |
| 2 | E. O. Doebelin, <i>“Measurement Systems: Applications and Design”</i> , Tata McGraw-Hill Book Co, 2017                                                                   |
| 3 | D. Patranabis, <i>“Sensors and Transducers”</i> , Prentice Hall India Pvt. Ltd, 2007                                                                                     |
| 4 | Bela G. Liptak, <i>“INSTRUMENT ENGINEERS' HANDBOOK - Process Measurement and Analysis”</i> , CRC PRESS, Boca Raton London New York Washington, D.C, Fourth Edition, 2003 |

|   |                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | H. K. P. Neubert, <b>“Instrument Transducers – An Introduction to their Performance and Design”</b> , Oxford University Press, Cambridge, 2009 |
| 6 | W.Bolton, <b>“Engineering Science”</b> , Elsevier Newnes, Fifth edition, 2006.                                                                 |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping                             |                                                                                                                          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                      | PO1                                                                                                                      | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                          | 2                                                                                                                        | -        | 3        | 2        | -        | -        | -        | -        | 3        | 2        | -        | -        | 2        | 2        | 2        |
| CO2                                          | 2                                                                                                                        | -        | 3        | 2        | -        | -        | -        | -        | 3        | 2        | -        | -        | 2        | 2        | 2        |
| CO3                                          | 2                                                                                                                        | -        | 3        | 2        | -        | -        | -        | -        | 3        | 2        | -        | -        | 2        | 2        | 2        |
| CO4                                          | 2                                                                                                                        | -        | 3        | 2        | -        | -        | -        | -        | 3        | 2        | -        | -        | 2        | 2        | 2        |
| CO5                                          | 2                                                                                                                        | -        | 3        | 2        | -        | -        | -        | -        | 3        | 2        | -        | -        | 2        | 2        | 2        |
| <b>22NPC303</b>                              | <b>2</b>                                                                                                                 | <b>-</b> | <b>3</b> | <b>2</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>3</b> | <b>2</b> | <b>-</b> | <b>-</b> | <b>2</b> | <b>2</b> | <b>2</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial    |                                                                                                                          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| b) CO and Key Performance Indicators mapping |                                                                                                                          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| ASSESSMENT PATTERN - THEORY                                  |                   |                      |                |                |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 10                | 90                   | -              | -              | -                 | -               | 100     |
| CAT2                                                         | 10                | 90                   | -              | -              | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                 | 50                   | 40             | 10             | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                 | 50                   | 40             | 10             | -                 | -               | 100     |
| ESE                                                          | 10                | 90                   | -              | -              | -                 | -               | 100     |



## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                         |                     |
|-----------------|---------------------------------------------------------|---------------------|
| <b>22NPC304</b> | <b>ELECTRICAL AND ELECTRONIC MEASUREMENT TECHNIQUES</b> | <b>SEMESTER III</b> |
|-----------------|---------------------------------------------------------|---------------------|

| PREREQUISITES                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                           | CATEGORY | L | T | P | C         |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|----------|---|---|---|-----------|
| NIL                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                           | PC       | 3 | 0 | 0 | 3         |
| COURSE OBJECTIVE                                                                                                                                                                                                                                                                                                                                                                                                                             | To impart knowledge on various electrical, electronic and waveform analyzing instruments. |          |   |   |   |           |
| UNIT - I                                                                                                                                                                                                                                                                                                                                                                                                                                     | VOLTAGE AND CURRENT MEASUREMENTS                                                          |          |   |   |   | 9 Periods |
| Introduction to Electrical Measurements - Construction, Principle of Operation, Torque Equation, Errors and Applications: Moving Coil, Moving Iron and Dynamometer Type Instruments - Thermal Type Instruments - Rectifier Type Instruments - Extension of Instrument Range - Calibration of Instruments - AC and DC Current Probes.                                                                                                         |                                                                                           |          |   |   |   |           |
| UNIT - II                                                                                                                                                                                                                                                                                                                                                                                                                                    | POWER AND ENERGY MEASUREMENTS                                                             |          |   |   |   | 9 Periods |
| Power Measurement: Constructional Details, Derivation of Power, Errors and Compensation of Electro-Dynamic Wattmeter - Thermal Wattmeter - Single and Three Phase Power Measurements - Low Power Factor Wattmeter - Calibration of Wattmeter - Energy Measurement: Construction, Working Principle, Energy Equation of Single Phase Induction Type Energy Meter - Three Phase Energy Meters - Phantom Loading - Calibration of Energy Meter. |                                                                                           |          |   |   |   |           |
| UNIT - III                                                                                                                                                                                                                                                                                                                                                                                                                                   | MEASUREMENT USING BRIDGES                                                                 |          |   |   |   | 9 Periods |
| DC Bridges: Wheatstone Bridge, Modified Wheatstone Bridge, Kelvin Double Bridge - Megger - AC Bridges: Maxwell's Inductance bridge, Maxwell's Inductance Capacitance bridge, Hay's bridge, Anderson's bridge, Wien's bridge and Schering bridge.                                                                                                                                                                                             |                                                                                           |          |   |   |   |           |
| UNIT - IV                                                                                                                                                                                                                                                                                                                                                                                                                                    | ELECTRONIC MEASUREMENTS                                                                   |          |   |   |   | 9 Periods |
| Digital Meters: Voltmeter, Wattmeter and Multimeter - True RMS Meter - Q Meter - Signal Generator: Sine, Step and Ramp Generation - Function Generator - Digital Methods of Measuring Time, Frequency, Period, Phase Difference, Pulse Width - Digital Display: LED, LCD, Segmented and Dot Matrix Displays.                                                                                                                                 |                                                                                           |          |   |   |   |           |
| UNIT - V                                                                                                                                                                                                                                                                                                                                                                                                                                     | WAVEFORM ANALYZING INSTRUMENTS                                                            |          |   |   |   | 9 Periods |
| Cathode Ray Oscilloscopes: Block Diagram, Waveform Generation - Measurement of Electrical Quantities using CRO – Digital Storage Oscilloscopes - Wave Analyzer - Spectrum Analyzer –Harmonic Distortion Analyzer – Elements of Data Acquisition System - Introduction to Virtual Instrumentation : Hardware and Software, VI for Test, Control and Design, VI in Engineering.                                                                |                                                                                           |          |   |   |   |           |
| Contact Periods: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                           |          |   |   |   |           |
| Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods                                                                                                                                                                                                                                                                                                                                                |                                                                                           |          |   |   |   |           |

**TEXT BOOKS:**

|   |                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>A.K. Sawhney, Puneet Sawhney, "A Course in Electronic and Electrical Measurements and Instrumentation", S.K.Kataria &amp; Sons, Delhi, 2014.</i> |
| 2 | <i>J. B. Gupta, "Electronics Measurements and Instrumentation", S.K.Kataria &amp; Sons, Delhi, 2013.</i>                                            |

**REFERENCES:**

|   |                                                                                                                                   |
|---|-----------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Kalsi.H.S, "Electronic Instrumentation", Tata McGraw Hill Education Private Limited, Fourth Edition, 2019.</i>                 |
| 2 | <i>David.A.Bell, "Electronic Instrumentation and Measurement Techniques" Prentice Hall, Third Edition, 2013.</i>                  |
| 3 | <i>E.W. Golding and F.C. Widdis, "Electrical Measurements and Measuring Instruments" A.H.Wheeler and Co, Fifth Edition, 2011.</i> |
| 4 | <i>Jovitha Jerome, "Virtual Instrumentation using Labview", PHI Learning Private Limited, New Delhi, 2010.</i>                    |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                              | <b>Bloom's Taxonomy Mapped</b> |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------------------------------|
| CO1                                                                                   | Describe the construction and operation of various analog instruments.                       | K2                             |
| CO2                                                                                   | Analyze the methods for the measurement of power and energy.                                 | K4                             |
| CO3                                                                                   | Determine circuit parameters using AC and DC bridges.                                        | K2                             |
| CO4                                                                                   | Identify suitable electronic instruments for the measurement of electrical parameters.       | K2                             |
| CO5                                                                                   | Interpret the operation and application of oscilloscopes and waveform analyzing instruments. | K3                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                             |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|-------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                             | PO1                                                         | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 2                                                           | 1        | 1        | -        | -        | 2        | -        | -        | -        | -        | -        | -        | 3        | 2        | -        |
| CO2                                                 | 3                                                           | 1        | 2        | -        | 1        | 2        | -        | -        | -        | -        | -        | -        | 3        | 2        | -        |
| CO3                                                 | 2                                                           | 2        | 2        | -        | 1        | -        | -        | -        | -        | -        | -        | -        | 3        | 2        | -        |
| CO4                                                 | 1                                                           | 1        | 1        | -        | 1        | 2        | -        | -        | -        | -        | -        | -        | 3        | 2        | -        |
| CO5                                                 | 2                                                           | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 3        | 2        | -        |
| <b>22NPC304</b>                                     | <b>2</b>                                                    | <b>2</b> | <b>2</b> | <b>-</b> | <b>1</b> | <b>2</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>3</b> | <b>2</b> | <b>-</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                             |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                             |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                                 | 1.2.1,1.3.1,2.1.2,2.1.3,3.1.1                               |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.2.3,2.3.1,2.4.1,3.1.1,3.1.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                                 | 1.2.1,1.3.1,2.1.2,2.1.3,2.2.1,2.3.2,2.4.1,3.1.1,3.4.1       |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                                 | 1.2.1,2.1.3,3.1.1,3.1.2                                     |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                                 | 1.2.1,1.4.1,2.2.2,2.1.3,3.1.1,3.1.2                         |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 60                   | 20             | -               | -                 | -               | 100     |
| CAT2                                                         | 20                | 60                   | 10             | 10              | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                 | 60                   | 40             | -               | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                 | 60                   | 40             | -               | -                 | -               | 100     |
| ESE                                                          | 10                | 50                   | 20             | 20              | -                 | -               | 100     |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                           |                     |
|-----------------|-----------------------------------------------------------|---------------------|
| <b>22NMC3Z2</b> | <b>CONSTITUTION OF INDIA<br/>(Common to All Branches)</b> | <b>SEMESTER III</b> |
|-----------------|-----------------------------------------------------------|---------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | MC       | 3 | 0 | 0 | 0 |

|                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                  |                  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                            | To familiarize the students on the role, powers and functions of Indian government and also understand the recent acts in India. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                    | <b>INTRODUCTION AND EMERGENCY PROVISIONS</b>                                                                                     | <b>9 Periods</b> |  |
| Historical Background: The Company rule, The Crown rule - Constituent Assembly: Composition, Objectives - Preamble and Salient features of the Indian Constitution - Fundamental Rights, Fundamental Duties, Directive Principles of state policy, Emergency Provisions - National Emergency, President Rule, Financial Emergency. |                                                                                                                                  |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                   | <b>SYSTEM OF GOVERNMENT</b>                                                                                                      | <b>9 Periods</b> |  |
| Parliamentary system: merits, demerits, reasons for adopting parliamentary system – Federal system: Evaluation of federal features –Centre-State relations: Legislative, Administrative and Financial relations – Local Government: Panchayat Raj and urban local government.                                                      |                                                                                                                                  |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                  | <b>UNION AND STATE GOVERNMENT</b>                                                                                                | <b>9 Periods</b> |  |
| President of India: Election, Powers and functions - Prime Minister and Cabinet: Structure and functions – Governor: Powers and functions - Chief Minister and Council of Ministers: Functions.                                                                                                                                    |                                                                                                                                  |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                   | <b>ORGANS OF GOVERNANCE AND RECENT ACTS</b>                                                                                      | <b>9 Periods</b> |  |
| Parliament: Lok Sabha and Rajya Sabha, Composition and powers - State Legislative Assembly and Legislative Council: Composition and powers - Judicial System in India: Structure and features - Supreme Court and High Court: Composition, Jurisdiction, Recent acts in significance-RTI, Citizenship act, POCSO Act.              |                                                                                                                                  |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                    | <b>POLITICAL DYNAMICS</b>                                                                                                        | <b>9 Periods</b> |  |
| Political parties: Party system, Recognition of National and State parties – Elections: Electoral system and reforms – Pressure groups – National Integration: Obstacles, National Integration Council – Foreign Policy: Principles and Objectives.                                                                                |                                                                                                                                  |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                 |                                                                                                                                  |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                               |                                                                                                                                  |                  |  |

## TEXT BOOKS:

|   |                                                                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | National portal of India, " <b>The Constitution of India</b> " (Full Text),<br><a href="https://legislative.gov.in/constitution-of-india">https://legislative.gov.in/constitution-of-india</a> |
| 2 | Dr.B.R.Ambedkar, " <b>The Constitution of India</b> ", Sudhir Prakashan, 2020.                                                                                                                 |

## REFERENCES:

|   |                                                                                        |
|---|----------------------------------------------------------------------------------------|
| 1 | Durga Das Basu, " <b>Introduction to the Constitution of India</b> ", LexisNexis, 2022 |
| 2 | P.M.Bakshi, " <b>The Constitution of India</b> ", LexisNexis, 2020                     |
| 3 | Subash C Kashyap, " <b>Our Parliament</b> ", National Book Trust, 2021                 |
| 4 | Subash C Kashyap, " <b>Our Political System</b> ", National Book Trust, 2011           |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b>                                      |                                                                   | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                   |                                |
| CO1                                                         | Know the evolution of Indian Constitution and its basic premises. | K1                             |
| CO2                                                         | Explain the system of governance in India.                        | K2                             |
| CO3                                                         | Describe the structure of Union and State Governments             | K2                             |
| CO4                                                         | Obtain the knowledge of functions of Legislature and Judiciary    | K1                             |
| CO5                                                         | Know the political system of India                                | K1                             |

**COURSE ARTICULATION MATRIX**

| a) CO/PO Mapping                             |                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |  |
|----------------------------------------------|-------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|--|
| COs/POs                                      | PO1                                 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |  |
| CO1                                          | -                                   | -   | -   | -   | -   | 1   | -   | 1   | 1   | -    | -    | -    | -    | -    | -    |  |
| CO2                                          | -                                   | -   | -   | -   | -   | 1   | -   | 1   | 1   | -    | -    | -    | -    | -    | -    |  |
| CO3                                          | -                                   | -   | -   | -   | -   | 2   | -   | 2   | 1   | -    | -    | -    | -    | -    | -    |  |
| CO4                                          | -                                   | -   | -   | -   | -   | 1   | -   | 1   | 2   | -    | -    | -    | -    | -    | -    |  |
| CO5                                          | -                                   | -   | -   | -   | -   | 2   | -   | 2   | 1   | -    | -    | -    | -    | -    | -    |  |
| 22NMC3Z2                                     | -                                   | -   | -   | -   | -   | 1   | -   | 1   | 1   | -    | -    | -    | -    | -    | -    |  |
| 1 – Slight, 2 – Moderate, 3 – Substantial    |                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |  |
| b) CO and Key Performance Indicators mapping |                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |  |
| CO1                                          | 6.1.1,6.2.1,8.1.1,8.2.1,8.2.2,9.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |  |
| CO2                                          | 6.1.1,6.2.1,8.1.1,8.2.1,8.2.2,9.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |  |
| CO3                                          | 6.1.1,6.2.1,8.1.1,8.2.1,8.2.2       |     |     |     |     |     |     |     |     |      |      |      |      |      |      |  |
| CO4                                          | 6.1.1,6.2.2,9.1.2,9.2.1             |     |     |     |     |     |     |     |     |      |      |      |      |      |      |  |
| CO5                                          | 6.2.2,8.1.1,8.2.2,9.1.2,9.2.1       |     |     |     |     |     |     |     |     |      |      |      |      |      |      |  |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 50                | 50                   | -              | -              | -                 | -               | 100     |
| CAT2                                                         | 50                | 50                   | -              | -              | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 50                | 50                   | -              | -              | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 50                | 50                   | -              | -              | -                 | -               | 100     |
| ESE                                                          | 50                | 50                   | -              | -              | -                 | -               | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                |                     |
|-----------------|----------------------------------------------------------------|---------------------|
| <b>22NES307</b> | <b>ENGINEERING EXPLORATION FOR INSTRUMENTATION ENGINEERING</b> | <b>SEMESTER III</b> |
|-----------------|----------------------------------------------------------------|---------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|----------------------|-----------------|----------|----------|----------|------------|
| <b>NIL</b>           | <b>ES</b>       | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                              |                   |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | The objective of the course is to provide an introduction to the engineering field. It is designed to help the student to learn about engineering and how it is useful in our everyday life. |                   |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>INTRODUCTION</b>                                                                                                                                                                          | <b>15 Periods</b> |  |
| Introduction to Engineering and Engineering study: Difference between science and engineering, scientist and engineer needs and wants, various disciplines of engineering, some misconceptions of engineering, expectation for the 21 <sup>st</sup> century engineer and Graduate Attributes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                              |                   |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>ENGINEERING DESIGN</b>                                                                                                                                                                    | <b>15 Periods</b> |  |
| Engineering Requirement, Knowledge within Engineering disciplines, Engineering advancements , Problem definition , Idea generation through brain storming and researching, solution creation through evaluating and communicating , text/analysis, final solution and design improvement.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                              |                   |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>ENGINEERING DISCIPLINES</b>                                                                                                                                                               | <b>15 Periods</b> |  |
| <b>Electronics and Instrumentation Engineering:</b> Reading analog multimeter, Measuring current, voltage and resistance, resistor colour code, electricity from chemicals, solar cells, magnets. Ohm's law and Watts law, Breadboard connections - Series and Parallel combination - circuit identification and circuit power consumption calculation, basic troubleshooting and continuity check.<br>Ring main wiring - Troubleshooting Electrical wiring - Dismantling and reassembling of Appliances (eg. Fans, motors etc.,)<br>Functionalities and operational procedures of RPS/AFO/CRO/DMM/LCR meter - Functionalities and Selection of Analog and Digital meters<br>Interpretation of Datasheets - Overview of simulation and design tools<br>Identifying electronic components and understanding PCB glossary - Conversion of schematic into PCB layout and PCB fabrication - Practicing of soldering and desoldering - PCB trouble shooting |                                                                                                                                                                                              |                   |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                              |                   |  |
| <b>Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                              |                   |  |

**REFERENCES:**

|          |                                                                                                                                                                                |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | Ryan A Brown, Joshua W. Brown and Michael Berkihsier: " <b>Engineering Fundamentals: Design, Principles, and Careers</b> ", Goodheart-Willcox Publisher, Second edition, 2014. |
| <b>2</b> | Saeed Moaveni, " <b>Engineering Fundamentals: An Introduction to Engineering</b> ", Cengage learning, Fourth Edition, 2011.                                                    |

| <b>COURSE OUTCOMES</b>                                      |                                                                                                                                                    | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                                                                                    |                                |
| CO1                                                         | Explain technological and engineering development , change and impacts of engineering                                                              | K2                             |
| CO2                                                         | Complete initial steps (Define a problem list criteria and constraints , Brainstorm potential solutions and document ideas) in engineering designs | K3                             |
| CO3                                                         | Communicate possible solutions through drawings and prepare project reports.                                                                       | K3                             |
| CO4                                                         | Draw sketches to a Design problem.                                                                                                                 | K3                             |
| CO5                                                         | Apply the concept of engineering fundamentals in Electronics and Instrumentation Engineering.                                                      | K3                             |

**COURSE ARTICULATION MATRIX****a) CO/PO Mapping**

| COs/POs         | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| CO1             | 2   | -   | 1   | 3   | 1   | 2   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |
| CO2             | 2   | -   | 1   | 3   | 1   | 2   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |
| CO3             | 2   | -   | 1   | 3   | 1   | 2   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |
| CO4             | 2   | -   | 1   | 3   | 1   | 2   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |
| CO5             | 2   | -   | 1   | 3   | 1   | 2   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |
| <b>22NES307</b> | 2   | -   | 1   | 3   | 1   | 2   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |

1 – Slight, 2 – Moderate, 3 – Substantial

**b) CO and Key Performance Indicators mapping**

|     |                                                                                                                                                                             |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.2.1, 1.3.1, 3.1.1, 3.1.4, 3.1.6, 4.1.1, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1 |
| CO2 | 1.2.1, 1.3.1, 3.1.1, 3.1.4, 3.1.6, 4.1.1, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1 |
| CO3 | 1.2.1, 1.3.1, 3.1.1, 3.1.4, 3.1.6, 4.1.1, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1 |
| CO4 | 1.2.1, 1.3.1, 3.1.1, 3.1.4, 3.1.6, 4.1.1, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1 |
| CO5 | 1.2.1, 1.3.1, 3.1.1, 3.1.4, 3.1.6, 4.1.1, 4.1.3, 4.1.4, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 6.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1 |



|                 |                                            |                     |
|-----------------|--------------------------------------------|---------------------|
| <b>22NPC305</b> | <b>SENSORS AND MEASUREMENTS LABORATORY</b> | <b>SEMESTER III</b> |
|-----------------|--------------------------------------------|---------------------|

| <b>PREREQUISITES</b>                                                                                                                              | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|----------|----------|------------|
| <ul style="list-style-type: none"> <li><b>SENSORS AND TRANSDUCERS</b></li> <li><b>ELECTRICAL AND ELECTRONIC MEASUREMENT TECHNIQUES</b></li> </ul> | <b>PC</b>       | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |

|                         |                                                                                                                                                                                                              |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | To involve students in performing experiments with a range of sensors and measurement systems by selecting appropriate tools and equipment and complying with all occupational health and safety procedures. |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**LIST OF EXPERIMENTS**

1. Characteristics of Photodiode and LDR
2. Characteristics of RTD, Thermistor, Thermocouple and IC sensors.
3. Characteristics of Linear Variable Displacement Transducer (LVDT )
4. Characteristics of Strain Gauge and Load Cell
5. Loading effect of Potentiometer
6. Angle measurement using Digital Transducer – Shaft Angle Encoder
7. Characteristics of Pressure Transducer
8. Measurement of resistance using Wheatstone and Kelvin's bridges
9. Measurement of capacitance using Schering Bridge
10. Measurement of inductance using Anderson and Maxwell Bridges
11. Measurement of frequency using Wien's bridge
12. Measurement of electrical quantities using the oscilloscope

**Contact Periods: 45 Periods****Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods**

| <b>COURSE OUTCOMES</b>                                      |                                                                                                                                                      | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                                                                                      |                                |
| CO1                                                         | Demonstrate the ability to characterize temperature and light transducers individually by performing experiments                                     | K3                             |
| CO2                                                         | Show the skill to characterize Displacement transducers, and load cells by performing experiments                                                    | K3                             |
| CO3                                                         | Analyze the effect of transducer loading on the circuit by conducting a suitable experiment                                                          | K4                             |
| CO4                                                         | Perform individually necessary experiments to measure select physical variables like shaft angle and pressure                                        | K3                             |
| CO5                                                         | Exhibit competency in measuring electrical parameters like resistance, capacitance and inductance by selecting suitable transducers and instruments. | K3                             |

**COURSE ARTICULATION MATRIX****a) CO/PO Mapping**

| COs/POs         | PO1      | PO2      | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9      | PO10     | PO11 | PO12     | PSO1     | PSO2     | PSO3 |
|-----------------|----------|----------|-----|-----|-----|-----|-----|-----|----------|----------|------|----------|----------|----------|------|
| CO1             | 3        | 2        | -   | -   | -   | -   | -   | -   | 3        | 3        | -    | 3        | 3        | 2        | -    |
| CO2             | 3        | 2        | -   | -   | -   | -   | -   | -   | 3        | 3        | -    | 3        | 3        | 2        | -    |
| CO3             | 3        | 2        | -   | -   | -   | -   | -   | -   | 3        | 3        | -    | 3        | 3        | 2        | -    |
| CO4             | 3        | 2        | -   | -   | -   | -   | -   | -   | 3        | 3        | -    | 3        | 3        | 2        | -    |
| CO5             | 3        | 2        | -   | -   | -   | -   | -   | -   | 3        | 3        | -    | 3        | 3        | 2        | -    |
| <b>22NPC305</b> | <b>3</b> | <b>2</b> | -   | -   | -   | -   | -   | -   | <b>3</b> | <b>3</b> | -    | <b>3</b> | <b>3</b> | <b>2</b> | -    |

1 – Slight, 2 – Moderate, 3 – Substantial

**b) CO and Key Performance Indicators mapping**

|     |                                                                                                                                                                                     |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.2.1,1.4.1,2.2.2,2.2.4,2.3.2,9.1.1,9.1.2, 9.2.1,9.2.2, 9.2.3, 9.3.1, 10.1.1., 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.1., 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2      |
| CO2 | 1.2.1, 1.4.1, 2.2.2, 2.2.4, 2.3.2, 9.1.1,9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2  |
| CO3 | 1.2.1, 1.4.1, 2.2.2, 2.2.4, 2.3.2, 9.1.1,9.1.2, 9.2.1 , 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |
| CO4 | 1.2.1, 1.4.1, 2.2.2, 2.2.4, 2.3.2, 9.1.1,9.1.2, 9.2.1 , 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |
| CO5 | 1.2.1, 1.4.1, 2.2.2, 2.2.4, 2.3.2, 9.1.1,9.1.2, 9.2.1 , 9.2.2, 9.2.3, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                          |                     |
|-----------------|----------------------------------------------------------|---------------------|
| <b>22NPC306</b> | <b>ELECTRICAL AND ELECTRONIC CIRCUITS<br/>LABORATORY</b> | <b>SEMESTER III</b> |
|-----------------|----------------------------------------------------------|---------------------|

| <b>PREREQUISITES</b>                                                                                                         | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|----------|----------|------------|
| <ul style="list-style-type: none"> <li><b>ELECTRICAL CIRCUITS AND NETWORKS</b></li> <li><b>ANALOG ELECTRONICS</b></li> </ul> | <b>PC</b>       | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |

|                         |                                                                                                      |
|-------------------------|------------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | To provide hands on experience on working with basic electrical components and semiconductor devices |
|-------------------------|------------------------------------------------------------------------------------------------------|

**LIST OF EXPERIMENTS**

1. Verification of Ohm's law and Kirchhoff's law
2. Circuit analysis using Mesh and Nodal analysis
3. Experimental verification of Norton's and Thevenin theorems
4. Experimental verification of Superposition and Maximum Power Transfer theorems
5. Transient analysis of RL, RC and RLC circuits
6. Analysis of parallel and series resonant circuits
7. Characteristics of diode and application as clipper circuits
8. Characteristics of Zener diode and application as a voltage regulator
9. Characteristics of BJT
10. Characteristics of UJT
11. Application of BJT as an amplifier and switch
12. Design of Multivibrator using BJT
13. Simulation of circuits using software tools

**Contact Periods: 45 Periods**

**Lecture: 0 Periods    Tutorial: 0 Periods    Practical: 45 Periods    Total: 45 Periods**

| <b>COURSE OUTCOMES</b>                                      |                                                                                      | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                      |                                |
| CO1                                                         | Measure voltages and currents in electric circuits                                   | K3                             |
| CO2                                                         | Analyze electric circuits using basic laws and theorems                              | K4                             |
| CO3                                                         | Obtain the characteristics of semiconductor devices                                  | K2                             |
| CO4                                                         | Calculate the hybrid parameters of transistor using its input-output characteristics | K3                             |
| CO5                                                         | Design application circuits like amplifiers, switch, multivibrators                  | K3                             |

**COURSE ARTICULATION MATRIX**

**a) CO/PO Mapping**

| COs/POs         | PO1      | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
|-----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO1             | 2        | 3        | 1        | 1        | 2        | -        | -        | 1        | 2        | 1        | 1        | 1        | 3        | -        | -        |
| CO2             | 3        | 3        | 1        | 1        | 2        | -        | -        | 1        | 2        | 1        | 1        | 1        | 3        | -        | -        |
| CO3             | -        | 2        | -        | 1        | 2        | -        | -        | 1        | 2        | 1        | 1        | 1        | 3        | -        | -        |
| CO4             | 3        | 3        | 1        | 1        | 1        | -        | -        | 1        | 2        | 1        | 1        | 1        | 3        | -        | -        |
| CO5             | 3        | 3        | 1        | 1        | 2        | -        | -        | 1        | 2        | 1        | 1        | 1        | 3        | -        | -        |
| <b>22NPC306</b> | <b>3</b> | <b>3</b> | <b>1</b> | <b>1</b> | <b>2</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>2</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>3</b> | <b>-</b> | <b>-</b> |

1 – Slight, 2 – Moderate, 3 – Substantial

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| b) CO and Key Performance Indicators mapping |                                                                                                                                                                                                                                            |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                          | 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4,3.4.2,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,8.1.1,9.1.1,9.2.2,9.2.3,9.3.1,10.1.2,10.1.3,11.3.1,12.1.2,12.3.1                                             |
| CO2                                          | 1.1.1,1.2.1,1.3.1,1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.2.3, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1,5.1.2,5.2.1,8.1.1,9.1.1,9.2.2,9.2.3,9.3.1,10.1.2,10.1.3, 11.3.1,12.1.2,12.3.1 |
| CO3                                          | 2.1.1,2.1.3,2.2.2,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,8.1.1,9.1.1,9.2.2, 9.2.3,9.3.1,10.1.2,10.1.3,11.3.1,12.1.2,12.3.1                                                                                      |
| CO4                                          | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3, 2.4.4,3.4.2,4.1.2,4.1.3,4.1.4,5.1.1,5.2.1,8.1.1,9.1.1,9.2.2,9.2.3,9.3.1,10.1.2,10.1.3,11.3.1,12.1.2, 12.3.1                         |
| CO5                                          | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1, 2.3.2, 2.4.1,2.4.2,2.4.3, 2.4.4,3.2.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,5.1.1,5.1.2,5.2.1,8.1.1,9.1.1,9.2.2,9.2.3,9.3.1,10.1.2,10.1.3, 11.3.1,12.1.2,12.3.1     |



## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                                    |                    |
|-----------------|------------------------------------------------------------------------------------|--------------------|
| <b>22NBS408</b> | <b>FOURIER SERIES AND TRANSFORM<br/>CALCULUS</b><br>(Common to EEE & EIE Branches) | <b>SEMESTER IV</b> |
|-----------------|------------------------------------------------------------------------------------|--------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>BS</b>       | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

|                         |                                                                                                                                                                                                                   |  |  |  |  |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| <b>COURSE OBJECTIVE</b> | The main objective of this course is to provide students with the foundations of Fourier series and transforms methods and analysis techniques mostly used in various applications in engineering and technology. |  |  |  |  |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|

|                 |                       |                      |
|-----------------|-----------------------|----------------------|
| <b>UNIT - I</b> | <b>FOURIER SERIES</b> | <b>9 + 3 Periods</b> |
|-----------------|-----------------------|----------------------|

Dirichlet's Conditions – General Fourier series –Odd and even functions- Half range Sine and Cosine series – Parseval's Identity on Fourier series–Harmonic Analysis.

|                  |                                |                      |
|------------------|--------------------------------|----------------------|
| <b>UNIT - II</b> | <b>BOUNDARY VALUE PROBLEMS</b> | <b>9 + 3 Periods</b> |
|------------------|--------------------------------|----------------------|

Classification of partial differential equations – Method of separation of variables–One dimensional wave equation–One dimensional heat equation –Transient and Steady state conditions–Fourier series solution.

|                   |                           |                      |
|-------------------|---------------------------|----------------------|
| <b>UNIT - III</b> | <b>LAPLACE TRANSFORMS</b> | <b>9 + 3 Periods</b> |
|-------------------|---------------------------|----------------------|

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Inverse Laplace transform. Convolution theorem. Evaluation of integrals by Laplace transform, solving ordinary differential equations by Laplace Transform method

|                  |                           |                      |
|------------------|---------------------------|----------------------|
| <b>UNIT - IV</b> | <b>FOURIER TRANSFORMS</b> | <b>9 + 3 Periods</b> |
|------------------|---------------------------|----------------------|

Statement of Fourier integral Theorem–Fourier transform pair–Fourier Sine and Cosine Transforms–Properties –Transforms of Simple functions–Convolution Theorem–Parseval's Identity-Finite Fourier transforms.

|                 |                     |                      |
|-----------------|---------------------|----------------------|
| <b>UNIT - V</b> | <b>Z-TRANSFORMS</b> | <b>9 + 3 Periods</b> |
|-----------------|---------------------|----------------------|

Z-transforms - Elementary properties-Inverse Z-transforms - Initial and Final value theorems - Convolution theorem – Formation of difference equations-Solution to difference equations of second order with constant coefficients using Z- transform.

**Contact Periods:**

**Lecture: 45 Periods    Tutorial: 15 Periods    Practical: 0 Periods    Total: 60 Periods**

**TEXT BOOKS:**

|   |                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Kandasamy, Thilagavathy and Gunavathy., " <b>Engineering Mathematics</b> " for III Semester, S.Chand & Co, Ramnagar, New Delhi, Revised edition 2017. |
| 2 | Veerarajan.T., " <b>Transforms and partial Differential equations</b> ", Tata Mc Graw Hill Publishing Co., New Delhi, 2015                            |

**REFERENCES:**

|   |                                                                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | J.Ray Hanna And John H. Rowland, " <b>Fourier Series , Transforms and Boundary Value Problems</b> ", Dover Publication Inc, Mineola, New York, Second Edition , 2008. |
| 2 | B.S.Grewal, " <b>Higher Engineering Mathematics</b> ", Khanna Publishers, New Delhi, 44 <sup>th</sup> Edition, 2018.                                                  |
| 3 | Ray Wylie C and Louis C Barrett, " <b>Advanced Engineering Mathematics</b> ", McGraw Hill Education(India) Pvt Ltd., New Delhi, 6 <sup>th</sup> Edition 2014.         |
| 4 | N.P.Bali and Manish Goyal., " <b>Transforms and partial Differential equations</b> ", University Science Press, New Delhi, 2010.                                      |
| 5 | S. Larsson, V. Thomee, " <b>Partial Differential Equations with Numerical Methods</b> ", Springer, 2003.                                                              |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                                                                                            | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Express the periodic functions arising in the study of engineering problems as trigonometric series.                                                       | K5                                     |
| CO2                                                                                   | Solve the partial differential equation arising in engineering problems as wave and heat flow in steady state (Cartesian coordinate) using Fourier series. | K5                                     |
| CO3                                                                                   | Apply Laplace Transform technique to solve the given integral equation s and ordinary differential equations.                                              | K5                                     |
| CO4                                                                                   | Find Fourier transforms, finite and infinite Fourier sine and cosine transforms.                                                                           | K5                                     |
| CO5                                                                                   | Apply the Z transform methods to find solutions of difference equations in engineering problem.                                                            | K5                                     |

### COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                                                                                             | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                                                                                                               | 2   | 2   | 3   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    | -    | -    |
| CO2                                                 | 3                                                                                                                                                                                               | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    | -    | -    |
| CO3                                                 | 3                                                                                                                                                                                               | 2   | 2   | 3   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    | -    | -    |
| CO4                                                 | 3                                                                                                                                                                                               | 2   | 2   | 3   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    | -    | -    |
| CO5                                                 | 3                                                                                                                                                                                               | 2   | 2   | 3   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    | -    | -    |
| <b>22NBS408</b>                                     | 3                                                                                                                                                                                               | 2   | 2   | 3   | -   | -   | -   | -   | -   | -    | -    | 1    | 2    | -    | -    |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                                                                                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.1, 3.1.6, 3.2.2, 3.2.3, 3.3.1, 3.4.2 4.1.1, 4.1.2, 4.1.4, 4.2.2, 4.3.2, 4.3.3, 4.3.4, 11.2.1, 11.3.1, 12.1.2, 12.3.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.1, 3.1.6, 3.2.2, 3.2.3, 3.3.1, 3.4.2 4.1.1, 4.1.2, 4.1.4, 4.2.2, 11.2.1, 11.3.1, 12.1.2, 12.3.2.                      |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.1, 3.1.6, 3.2.2, 3.2.3, 3.3.1, 3.4.2 4.1.1, 4.1.2, 4.1.4, 4.2.2, 4.3.2, 4.3.3, 4.3.4, 11.2.1, 11.3.1, 12.1.2, 12.3.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.1, 3.1.6, 3.2.2, 3.2.3, 3.3.1, 3.4.2 4.1.1, 4.1.2, 4.1.4, 4.2.2, 4.3.2, 4.3.3, 4.3.4, 11.2.1, 11.3.1, 12.1.2, 12.3.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.1, 3.1.6, 3.2.2, 3.2.3, 3.3.1, 3.4.2 4.1.1, 4.1.2, 4.1.4, 4.2.2, 4.3.2, 4.3.3, 4.3.4, 11.2.1, 11.3.1, 12.1.2, 12.3.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                | 45                   | 35             | -               | -                 | -               | 100     |
| CAT2                                                         | 15                | 45                   | 40             | -               | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 45                   | 35             | -               | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 25                | 40                   | 35             | -               | -                 | -               | 100     |
| ESE                                                          | 25                | 40                   | 35             | -               | -                 | -               | 100     |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                            |                    |
|-----------------|----------------------------|--------------------|
| <b>22NES408</b> | <b>ELECTRICAL MACHINES</b> | <b>SEMESTER IV</b> |
|-----------------|----------------------------|--------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>ES</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                     |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                   | To impart the knowledge on principle of operation, performance, testing of different electrical machines and identify their suitability for real time applications. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                           | <b>DC MACHINES</b>                                                                                                                                                  | <b>9 Periods</b> |  |
| DC generator: Constructional details and principle of operation – emf equation – Types of dc generators – Characteristics - losses and efficiency – applications. DC Motors: Constructional details and principle of operation – back emf – Types of dc motors – Torque equation – losses and efficiency – characteristics – Three point Starter – Speed control methods. |                                                                                                                                                                     |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                          | <b>TRANSFORMERS</b>                                                                                                                                                 | <b>9 Periods</b> |  |
| Principle of operation – Types and constructional features of single phase and three phase transformers – EMF equation - Phasor diagram – Transformers on load and No Load - Equivalent circuit – Voltage Regulation and efficiency – All day efficiency – Auto transformers.                                                                                             |                                                                                                                                                                     |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                         | <b>INDUCTION MACHINES</b>                                                                                                                                           | <b>9 Periods</b> |  |
| Constructional features of three phase Induction motors – Principle of Operation – torque-slip characteristics – Load test – No load and blocked rotor tests – Equivalent circuit - starting, and speed control methods – solid state control (Qualitative).                                                                                                              |                                                                                                                                                                     |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                          | <b>SYNCHRONOUS MACHINES</b>                                                                                                                                         | <b>9 Periods</b> |  |
| Alternator: Types and constructional features – emf equation – Phasor diagrams – Voltage Regulation. Motor: Construction - Principle of operation - V and inverted V curves – Starting methods – Current loci for constant power input, constant excitation and constant power developed – Applications.                                                                  |                                                                                                                                                                     |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                           | <b>SPECIAL MOTORS AND INTRODUCTION TO DRIVES</b>                                                                                                                    | <b>9 Periods</b> |  |
| Single phase induction motor-Construction details-Double field revolving theory and operation. Switched Reluctance Motor – Stepper motors – PMDC motor – BLDC motor. Introduction to drives - Types of electrical drives – factors influencing the choice of electrical drives loading conditions and classes of duty- determination of power rating                      |                                                                                                                                                                     |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                     |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                      |                                                                                                                                                                     |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Kothari D.P. and Nagrath I.J “Electric Machines” Tata McGraw Hill, Reprint, 2017</i>                                             |
| 2 | <i>Theraja B.L. and Theraja A.K “A Text Book of Electrical Technology- Vol. II”, S.Chand and Co. Ltd., New Delhi, Reprint, 2019</i> |

**REFERENCES:**

|   |                                                                                               |
|---|-----------------------------------------------------------------------------------------------|
| 1 | <i>Fitzgerald A.E.,Kingsly C. and Kusko A. “Electric Machinery” Tata McGraw Hill, 2017</i>    |
| 2 | <i>Stephen J Chapman “Electric Machinery” Tata McGraw Hill, Fourth Edition 2015</i>           |
| 3 | <i>Sen.S.K, “Electric Drives” Prentice Hall, Reprint 2019</i>                                 |
| 4 | <i>Vedam Subramaniam “ Electric Drives- Concepts and Applications” Tata McGraw Hill ,2011</i> |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                             | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Interpret the construction, working, characteristics and applications of AC and DC machines | K3                                     |
| CO2                                                                                   | Familiarize the functioning of transformers and Analyze its performance                     | K4                                     |
| CO3                                                                                   | Appraise the working of induction motors and suitable inductive and model it                | K4                                     |
| CO4                                                                                   | Discriminate the types of synchronous machines and specify their uses for practical utility | K4                                     |
| CO5                                                                                   | Familiarize the operation of single phase induction motors, special machines and drives.    | K2                                     |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                                             | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                                                               | 3   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO2                                                 | 3                                                                                                                                               | 3   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO3                                                 | 3                                                                                                                                               | 3   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO4                                                 | 3                                                                                                                                               | 3   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO5                                                 | 3                                                                                                                                               | 3   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| <b>22NES408</b>                                     | 3                                                                                                                                               | 3   | 1   | 1   | 1   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4,3.1.1,3.2.1,3.2.2,3.2.3,4.1.1,5.1.2       |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.2.1,3.2.2,3.2.3,4.1.1,5.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.2.1,3.2.2,3.2.3,4.1.1,5.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4,3.1.1,3.2.1,3.2.2,3.2.3,4.1.1,5.1.2       |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4,3.1.1,3.2.1,3.2.2,3.2.3,4.1.1,5.1.2       |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 30                   | 30             | 30             | -                 | -               | 100     |
| CAT2                                                         | 10                | 30                   | 30             | 30             | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                 | 30                   | 30             | 40             | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                 | 30                   | 30             | 40             | -                 | -               | 100     |
| ESE                                                          | 10                | 30                   | 30             | 30             | -                 | -               | 100     |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|          |                                          |             |
|----------|------------------------------------------|-------------|
| 22NPC407 | ELECTRONICS FOR ANALOG SIGNAL PROCESSING | SEMESTER IV |
|----------|------------------------------------------|-------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PC       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                          |                                                                                              |                  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                  | To impart knowledge on the working and applications of operational amplifiers, ADCs and DACs |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                          | <b>IC FABRICATION AND CHARACTERISTICS</b>                                                    | <b>9 Periods</b> |  |
| IC Classification - Fundamentals of Monolithic IC Technology – Basic Planar Processes - Fabrication of Typical Circuit - Fabrication of Diode, Resistance, Capacitance, JFET and MOSFET- Ideal Op-Amp – Internal Circuit of Op-Amp – Improving CMRR - DC and AC characteristics.                                         |                                                                                              |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                         | <b>APPLICATIONS OF OP-AMP</b>                                                                | <b>9 Periods</b> |  |
| Applications of Op-Amp: Inverting and Non Inverting Amplifiers, Voltage Follower, Adder, Subtractor, Integrator, Differentiator, Instrumentation Amplifier, Voltage to Current and Current to Voltage converters, Sample and Hold Circuits, Log and Antilog Amplifier.                                                   |                                                                                              |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                        | <b>COMPARATORS AND WAVEFORM GENERATORS</b>                                                   | <b>9 Periods</b> |  |
| Op-amps Circuits: Comparator, Regenerative Comparator, Rectifier, Peak Detector, Clippers, Clampers – First Order and Second Order Low Pass and High Pass Active Filters - Monostable Multivibrators – Square Wave Generator - Triangular Wave Generator, Oscillators: RC Phase Shift, Wein Bridge                       |                                                                                              |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                         | <b>SPECIAL ICs AND APPLICATION ICs</b>                                                       | <b>9 Periods</b> |  |
| 555 Timer: Functional Diagram, Operation and Applications in Monostable and Astable Mode, Schmitt Trigger - Phase Locked Loop: Principle, Phase Detection/Comparison, Applications - Voltage Controlled Oscillator – Voltage Regulators: Fixed Voltage Series Regulator, General Purpose Regulator, Switching Regulator. |                                                                                              |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                          | <b>D/A AND A/D CONVERTERS</b>                                                                | <b>9 Periods</b> |  |
| DAC: Weighted Resistor, R-2R Ladder, Inverted R-2R types - ADC: Flash, Counter, Servo Tracking, Successive Approximation, Dual Slope types - DAC and ADC Specifications.                                                                                                                                                 |                                                                                              |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                       |                                                                                              |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                     |                                                                                              |                  |  |

## TEXT BOOKS:

|   |                                                                                                                                 |
|---|---------------------------------------------------------------------------------------------------------------------------------|
| 1 | Ramkant A Gayakwad, " <b>Op-Amps and Linear Integrated Circuits</b> ", Prentice Hall of India, Fourth Edition, 2009.            |
| 2 | Roy D Choudhary and Shail B Jain, " <b>Linear Integrated Circuits</b> ", New Age International Publishers, Fifth Edition, 2018. |

## REFERENCES:

|   |                                                                                                                                  |
|---|----------------------------------------------------------------------------------------------------------------------------------|
| 1 | William D Stanely, " <b>Operational Amplifiers with Linear Integrated Circuits</b> ", Pearson Education, Fourth Edition, 2009.   |
| 2 | Robert F. Coughlin, and Fredrick F. Driscoll, „ <b>Op-amp and Linear ICs</b> ", Pearson Education, Sixth Edition, 2012.          |
| 3 | David A. Bell, „ <b>Operational Amplifiers and Linear ICs</b> , Oxford Higher Education, 2013.                                   |
| 4 | Sergio Franco, „ <b>Design with Operational Amplifiers and Analog Integrated Circuits</b> ", Mc Graw Hill, 2016.                 |
| 5 | Robert F Coughlin, Frederick F Driscoll, " <b>Operational amplifiers and Integrated Circuits</b> " Prentice Hall of India, 2009. |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                     | <b>Bloom's Taxonomy Mapped</b> |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------|
| CO1                                                                                   | Discuss about IC fabrication procedure and characteristics of operational amplifier | K3                             |
| CO2                                                                                   | Compute the gain and output voltage of the given Op-Amp circuits                    | K3                             |
| CO3                                                                                   | Design Comparators and waveform generators using Op-Amps                            | K3                             |
| CO4                                                                                   | Explain the operation of voltage regulators and timers                              | K3                             |
| CO5                                                                                   | Design ADCs and DACs using Op-Amps.                                                 | K3                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                             | PO1                                                                                                   | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 3                                                                                                     | 3        | 1        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 3        | 1        | -        |
| CO2                                                 | 3                                                                                                     | 3        | 1        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 3        | 1        | -        |
| CO3                                                 | 3                                                                                                     | 3        | 1        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 3        | 1        | -        |
| CO4                                                 | 2                                                                                                     | 2        | 1        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 3        | 1        | -        |
| CO5                                                 | 2                                                                                                     | 2        | 1        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 3        | 1        | -        |
| <b>22NPC407</b>                                     | <b>3</b>                                                                                              | <b>3</b> | <b>1</b> | <b>1</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>3</b> | <b>1</b> | <b>-</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                                 | 1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.4,3.1.6,4.1.2,5.1.1       |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                                 | 1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.4,3.1.6,4.1.2,5.1.1       |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                                 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,3.1.6,4.1.2,5.1.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                                 | 1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.2,2.2.3,2.4.1,3.1.6,4.1.2,5.1.1                                     |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                                 | 1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.2,2.2.3,2.4.1,3.1.6,4.1.2,5.1.1                                     |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 30                | 60                   | 10             | -              | -                 | -               | 100     |
| CAT2                                                         | 30                | 60                   | 10             | -              | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                | 50                   | 20             | -              | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                | 50                   | 20             | -              | -                 | -               | 100     |
| ESE                                                          | 30                | 55                   | 15             | -              | -                 | -               | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                      |                            |                    |          |          |          |
|----------------------|----------------------------|--------------------|----------|----------|----------|
| <b>22NPC408</b>      | <b>DIGITAL ELECTRONICS</b> | <b>SEMESTER IV</b> |          |          |          |
| <b>PREREQUISITES</b> | <b>CATEGORY</b>            | <b>L</b>           | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>PC</b>                  | <b>3</b>           | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                         |                                                                                       |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                 | To introduce the fundamental concepts and design of digital system                    |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                         | <b>BOOLEAN ALGEBRA AND LOGIC FAMILIES</b>                                             | <b>9 Periods</b> |  |
| Review of Number Systems: Binary, Octal, Decimal, Hexadecimal – Conversions - Hamming Code - Boolean Algebra: Axioms, Laws and Theorems - Logic Gates - Minimization of Logic Function using K-Map and Quine-McCluskey Method - Implementation of Functions using Basic Gates and Universal Gates - Logic Families: TTL, ECL, and CMOS. |                                                                                       |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                        | <b>COMBINATIONAL CIRCUITS</b>                                                         | <b>9 Periods</b> |  |
| Design of Combinational Circuits: Half and Full Adder, Half and Full Subtractor, Binary Parallel Adder, Carry Look Ahead Adder, BCD Adders, Comparator, Encoder, Decoder, Multiplexer, Demultiplexer, Code Converters - Function Realization Using Multiplexers.                                                                        |                                                                                       |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                       | <b>SYNCHRONOUS SEQUENTIAL CIRCUITS</b>                                                | <b>9 Periods</b> |  |
| Flip Flops: SR, JK, D, T and their Conversions – Master/Slave Flip Flops - Shift Registers: SISO, SIPO, PIPO, PISO, Universal Shift Registers - Counters: Up, Down, Up/Down, Mod, Ring, Johnson - Design of Synchronous Sequential Circuits: Moore/Mealy Models of Serial Adder, Sequence Detector, Parity Generator, Counter.          |                                                                                       |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                        | <b>ASYNCHRONOUS SEQUENTIAL CIRCUITS, ALGORITHMIC STATE MACHINE AND MEMORY DEVICES</b> | <b>9 Periods</b> |  |
| Counter: Up, Down, Up/Down - Design and Analysis of Fundamental Mode Circuits -Algorithmic State Machine: ASM Chart, Design Examples - Memory Devices: ROM, RAM, PROM, EPROM - Programmable Logic Devices- ROM, PAL, PLA, PROM.                                                                                                         |                                                                                       |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                         | <b>INTRODUCTION TO VHDL</b>                                                           | <b>9 Periods</b> |  |
| Introduction to VHDL - Basic Elements of VHDL: Entity, Architecture, Configuration - Types of Modelling: Data Flow Modeling, Behavioral Modeling, Structural Modelling - Object Types - Data Types – Operator -. Simple VHDL Codes for Adders, Multiplexers, Demultiplexers, Flip-Flops, Counters.                                      |                                                                                       |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                      |                                                                                       |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                    |                                                                                       |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                        |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Morris Mano M, Michael D Ciletti, “ <b>Digital Design with an Introduction to Verilog HDL</b> ”, Pearson Education International, Sixth Edition, 2018. |
| 2 | Anand Kumar, “ <b>Fundamentals of Digital Circuits</b> ”, Prentice Hall of India, Fourth Edition 2016.                                                 |

**REFERENCES:**

|   |                                                                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Donald P Leach, Albert Paul Malvino, “ <b>Digital Principles and Applications</b> ”, Tata McGraw Hill Education Private Limited, New Delhi, Eighth Edition, 2014. |
| 2 | Ronald J Tocci, Neal S Widmer, Gregory L Moss, “ <b>Digital Systems: Principles and Applications</b> ”, Pearson Education International, Twelfth Edition, 2017.   |
| 3 | David J. Comer “ <b>Digital Logic and State Machine Design</b> ”, Oxford, Third Edition, 2016.                                                                    |
| 4 | James Palmer, David Perlman, “ <b>Schaum's Outline of Introduction to Digital Systems</b> ”, McGraw Hill, First Edition Reprint 2011.                             |
| 5 | Bhasker J, “ <b>VHDL Primer</b> ”, Prentice-Hall of India Pvt.Ltd, Third Edition, 2009.                                                                           |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                                                    | <b>Bloom's Taxonomy Mapped</b> |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------|
| CO1                                                                                   | Simplify the Boolean expressions using Boolean algebra, K map, Quine Mccluskey method and implement it using gates | K3                             |
| CO2                                                                                   | Design synchronous and asynchronous circuits using flip flops                                                      | K3                             |
| CO3                                                                                   | Implement logic functions using programmable logic devices                                                         | K3                             |
| CO4                                                                                   | Describe the operation of various logic families                                                                   | K2                             |
| CO5                                                                                   | Write VHDL codes for combinational and sequential circuits                                                         | K2                             |

### COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                                        | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                                                          | 3   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO2                                                 | 2                                                                                                                                          | 3   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO3                                                 | 2                                                                                                                                          | 3   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO4                                                 | 1                                                                                                                                          | 2   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO5                                                 | 2                                                                                                                                          | 3   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| <b>22NPC408</b>                                     | 2                                                                                                                                          | 3   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.2.3, 3.4.1, 4.3.3 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.2.3, 3.4.1, 4.3.3        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.2.3, 3.4.1, 4.3.3        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1, 2.1.2, 2.1.3, 2.2.2, 2.2.4, 2.3.1, 2.3.2                                                                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.2, 3.2.3, 4.1.2, 4.1.3                                    |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | -                 | 50                   | 50             | -              | -                 | -               | 100     |
| CAT2                                                         | -                 | 50                   | 50             | -              | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                 | 50                   | 50             | -              | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                 | 50                   | 50             | -              | -                 | -               | 100     |
| ESE                                                          | -                 | 50                   | 50             | -              | -                 | -               | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                   |                    |
|-----------------|-----------------------------------|--------------------|
| <b>22NPC409</b> | <b>INDUSTRIAL INSTRUMENTATION</b> | <b>SEMESTER IV</b> |
|-----------------|-----------------------------------|--------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PC</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                               |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To impart the concepts and terminologies involved in the measurement of industrial parameters |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>TEMPERATURE MEASUREMENT</b>                                                                | <b>9 Periods</b> |  |
| Definitions and Standards – Mechanical Type: Filled in System Thermometer, Sources of Errors in Filled in System, Compensation - Bimetallic Thermometers – Electrical Type: RTD, Characteristics, Signal Conditioning, 3 wire and 4 wire RTDs - Thermocouples: Laws of Thermocouple, Different Types, Reference Junction Compensation – Radiation Type: Total Radiation Pyrometers, Optical Pyrometers – Fiber Optic Sensor for Temperature Measurement – Temperature IC Sensors.                                                                                                                                         |                                                                                               |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>PRESSURE MEASUREMENT</b>                                                                   | <b>9 Periods</b> |  |
| Units of Pressure – Manometers: Different Types of Manometers - Elastic Type Pressure Gauges: Diaphragms, Capsules, Bellows and Bourdon tube - Electrical Type Pressure Gauges: LVDT, Strain Gauges, Capacitive and Piezo-resistive Pressure Sensor - Resonator Pressure Sensor - Measurement of Vacuum: McLeod Gauge, Thermal Conductivity Gauge, Ionization Gauges, Cold Cathode Type, Hot Cathode Type, Pirani Gauge – Calibration of Pressure Gauges – Dead Weight Tester.                                                                                                                                            |                                                                                               |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>MEASUREMENT OF FLOW</b>                                                                    | <b>9 Periods</b> |  |
| Variable Head Type Flow Meters: Expression for Flow Rate through Restriction - Orifice Plate - Different Types of Orifice Plates - Venturi Tube - Flow Nozzle - Pitot Tube - Installation and Applications of Head Flow Meters - Variable Area Flow Meter: Rotameter - Electrical Type Flow Meters: Construction, Principle of Operation, Applications of Electromagnetic Flow Meter, Ultrasonic Flow Meter, Laser Doppler Anemometer and Vortex Shedding Flow Meter - Positive Displacement Flow Meters: Nutating Disc, Reciprocating Piston and Oval Gear Flow Meters -Turbine Flow Meter - Calibration of Flow Meters. |                                                                                               |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>LEVEL MEASUREMENT</b>                                                                      | <b>9 Periods</b> |  |
| Different Types of Level Measurement: Float, Displacer, Hydrostatic, Thermal Effect Type - Electrical Methods: Resistive and Capacitive Type - Rotating Paddle Switches - Conductivity Sensors - Nucleonic Gauge - Ultrasonic Sensor - Nuclear Radiation Sensor - Solid Level Measurement - Transmitters: Principle of operation of Temperature, Pressure, Flow and Level Transmitters - Smart Transmitters.                                                                                                                                                                                                              |                                                                                               |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>MEASUREMENT OF VISCOSITY, HUMIDITY, MOISTURE AND DENSITY</b>                               | <b>9 Periods</b> |  |
| Viscosity: Saybolt, Rotameter and Torque Type Viscometers – Humidity: Dry and Wet Bulb Psychrometers – Resistive and Capacitive Type Hygrometers - Moisture: Conductivity, Capacitive, Microwave and IR Sensor Type – Density: Float, Gas Bridge, Pressure Head Type – pH Measurement – Safety Practices: Hazardous Areas and Classification – Intrinsic Safety - NEMA for Enclosures.                                                                                                                                                                                                                                    |                                                                                               |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                               |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                               |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                   |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Patranabis D, <b>“Principles of Industrial Instrumentation”</b> Third Edition, McGraw Hill Education Pvt. Ltd., 2016.                             |
| 2 | William C. Dunn, <b>“Fundamentals of Industrial Instrumentation and Process Control”</b> , Second Edition, McGraw Hill Education Pvt. Ltd., 2018. |

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### REFERENCES:

|   |                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Ernest O. Doebellin.E.O. and Manik D.N “ <i>Measurement systems Application and Design</i> ”, Seventh Edition, McGraw Hill Education Pvt. Ltd., 2019. |
| 2 | B. G. Liptak, “ <i>Instrumentation Engineers Handbook (Measurement)</i> ”, Fourth Edition, CRC Press, 2012.                                           |
| 3 | K. Krishnaswamy, “ <i>Industrial Instrumentation</i> ”, New Age International Publishers, New Delhi, 2013.                                            |
| 4 | S. K. Singh, “ <i>Industrial Instrumentation and Control</i> ”, Third Edition, Tata Mc Graw Hill Education Pvt. Ltd., New Delhi, 2009.                |

| COURSE OUTCOMES<br>Upon Completion of the course, the students will be able to |                                                                                                                                                        | Bloom's<br>Taxonomy<br>Mapped |
|--------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| CO1                                                                            | Select a suitable sensor for the measurement of different range of temperature.                                                                        | K2                            |
| CO2                                                                            | Describe the construction and working of different types of pressure measuring devices.                                                                | K2                            |
| CO3                                                                            | Interpret the concept of variable head, variable area and electrical type flow meters.                                                                 | K2                            |
| CO4                                                                            | Classify level sensors for liquid and solid type level measurement.                                                                                    | K2                            |
| CO5                                                                            | Identify the instruments for the measurement of viscosity, humidity, moisture, density and familiarize with the safety methods followed in industries. | K2                            |

### COURSE ARTICULATION MATRIX

#### a) CO/PO Mapping

| COs/POs         | PO1      | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
|-----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO1             | 2        | 2        | 1        | 3        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 3        | 2        |
| CO2             | 2        | 2        | 1        | 3        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 3        | 2        |
| CO3             | 2        | 2        | 1        | 3        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 3        | 2        |
| CO4             | 2        | 2        | 1        | 3        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 3        | 2        |
| CO5             | 2        | 2        | 1        | 3        | -        | 2        | 2        | -        | -        | -        | -        | -        | -        | 3        | 2        |
| <b>22NPC409</b> | <b>2</b> | <b>2</b> | <b>1</b> | <b>3</b> | <b>-</b> | <b>1</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>3</b> | <b>2</b> |

1 – Slight, 2 – Moderate, 3 – Substantial

#### b) CO and Key Performance Indicators mapping

|     |                                                                                                                                                                        |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.3, 3.1.4, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3               |
| CO2 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.3, 3.1.4, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3                      |
| CO3 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.3, 3.1.4, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3                      |
| CO4 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.3, 3.1.4, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3                      |
| CO5 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.2, 2.4.3, 3.1.4, 3.1.5, 3.4.2, 4.1.1, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 6.1.1, 7.1.2, 7.2.2 |

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| ASSESSMENT PATTERN - THEORY                                  |                   |                      |                |                |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 30                | 70                   | -              | -              | -                 | -               | 100     |
| CAT2                                                         | 30                | 70                   | -              | -              | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 50                | 50                   | -              | -              | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                 | 60                   | 40             | -              | -                 | -               | 100     |
| ESE                                                          | 40                | 60                   | -              | -              | -                 | -               | 100     |



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|                 |                                            |                    |
|-----------------|--------------------------------------------|--------------------|
| <b>22NPC410</b> | <b>FUNDAMENTALS OF SIGNALS AND SYSTEMS</b> | <b>SEMESTER IV</b> |
|-----------------|--------------------------------------------|--------------------|

| <b>PREREQUISITES</b>                                                                                                                       | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------|----------|----------|----------|----------|
| <ul style="list-style-type: none"> <li><b>LINEAR ALGEBRA AND CALCULUS</b></li> <li><b>FOURIER SERIES AND TRANSFORM CALCULUS</b></li> </ul> | <b>PC</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                         |                                                                                                                                                                                       |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | To familiarize signals and systems in terms of both time and transform domains, taking the advantage of the complementary sights and tools that these different perspectives provide. |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                 |                                                                |                  |
|-----------------|----------------------------------------------------------------|------------------|
| <b>UNIT - I</b> | <b>INTRODUCTION TO CONTINUOUS TIME SIGNALS(CT) AND SYSTEMS</b> | <b>9 Periods</b> |
|-----------------|----------------------------------------------------------------|------------------|

Introduction to signals and systems and their classifications. Definition of CT signal, Representation of elementary signals: Impulse, Pulse, Step, Ramp, Exponential Sinusoidal. Classification Of Signals:- periodic and aperiodic, power and energy, deterministic and random signals .Definition of CT system, Classification and characterization with examples:-Static, dynamic, causal, non causal, linear, nonlinear, time variant, time invariant, stable and unstable, FIR, IIR, reversible and irreversible, recursive non-recursive system.

|                  |                               |                  |
|------------------|-------------------------------|------------------|
| <b>UNIT - II</b> | <b>ANALYSIS OF CT SIGNALS</b> | <b>9 Periods</b> |
|------------------|-------------------------------|------------------|

Time domain analysis:-solutions of differential equations. Fourier series and Fourier transform of signals, spectrum of CT signals, and Gibb's phenomenon. Analysis of random signals.

|                   |                                             |                  |
|-------------------|---------------------------------------------|------------------|
| <b>UNIT - III</b> | <b>DISCRETIZATION SIGNAL RECONSTRUCTION</b> | <b>9 Periods</b> |
|-------------------|---------------------------------------------|------------------|

Discretization of signals: sample and hold circuit. Sampling:-Sampling theorem, selection of sampling rate, Types of sampling, Aliasing:-Aliasing effects, Anti-aliasing filter,Quantization:-Quantization errors due to truncation and rounding in fixed and floating point representations, Signal reconstruction:- Interpolation using zero-order and first-order hold.

|                  |                                                                  |                  |
|------------------|------------------------------------------------------------------|------------------|
| <b>UNIT - IV</b> | <b>CLASSIFICATION AND ANALYSIS OF DISCRETE TIME (DT) SIGNALS</b> | <b>9 Periods</b> |
|------------------|------------------------------------------------------------------|------------------|

DT signals:-Introduction, Definition, Elementary DT signals, Characterization. DT systems: Definition, Classification, Characterization. Time Domain Analysis:-Solutions of Difference Equations

|                 |                                                        |                  |
|-----------------|--------------------------------------------------------|------------------|
| <b>UNIT - V</b> | <b>TRANSFORM TECHNIQUES FOR DT SIGNALS AND SYSTEMS</b> | <b>9 Periods</b> |
|-----------------|--------------------------------------------------------|------------------|

Z-Transform-Definition, Properties, ROC and its properties, Inverse Z Transform. Analysis of LT systems using Z Transforms:-Stability, Causality, Recursive, Non-recursive systems.

**Contact Periods: 45 Periods**

**Lecture: 45 Periods    Tutorial: 0 Periods    Practical: 0 Periods    Total: 45 Periods**

**TEXT BOOKS :**

|   |                                                                                                                                                                          |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>P. Ramesh Babu &amp; R. Anandanatarajan, "Signals and System", Scitech Publications (India) Pvt Limited, 2007.</i>                                                    |
| 2 | <i>Tarun Kumar Rawat, "Signals and System", Oxford University Press,2010.</i>                                                                                            |
| 3 | <i>Proakis,J.G.,&amp; Manolakis,D.G., "Digital Signal Processing:Principles and Algorithms, &amp; Applications",3<sup>rd</sup> Edition, Prentice Hall of India,2007.</i> |

**REFERENCES:**

|   |                                                                                                                                    |
|---|------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Allan V. Oppenheim, S. Wilsky and S.H.Nawab, "Signals and Systems", Pearson Education, Indian Reprint, 2007.</i>                |
| 2 | <i>H P Hsu, "Signals and Systems (Schaum's Outlines)" Tata McGraw Hill,2006.</i>                                                   |
| 3 | <i>John Alan Stuller, "An Introduction to signals and Systems", Thomson, 2007.</i>                                                 |
| 4 | <i>Edward W Kamen, Bonnie S Heck, "Fundamentals of Signals and Systems using the Web and MATLAB" Pearson, Indian Reprint,2007.</i> |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                               | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Understanding the continuous time signal, systems and their classifications                   | K4                                     |
| CO2                                                                                   | Analyze continuous time systems in complex time domain                                        | K4                                     |
| CO3                                                                                   | Understand the process of sampling and the effects of under sampling and Signal reconstructio | K4                                     |
| CO4                                                                                   | Analyze discrete time signals, systems and time domain .                                      | K4                                     |
| CO5                                                                                   | Apply Z- transform for analysis of continuous-time and discrete-time signals and systems      | K4                                     |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                                                                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                                                                                                                                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                                                                                                                                                      | 3   | 2   | 3   | 1   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO2                                                 | 3                                                                                                                                                                                                                                      | 3   | 2   | 3   | 1   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO3                                                 | 3                                                                                                                                                                                                                                      | 3   | 2   | 3   | 1   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO4                                                 | 3                                                                                                                                                                                                                                      | 3   | 2   | 3   | 1   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO5                                                 | 3                                                                                                                                                                                                                                      | 3   | 2   | 3   | 1   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| <b>22NPC410</b>                                     | 3                                                                                                                                                                                                                                      | 3   | 2   | 3   | 1   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                                                                                                                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                                                                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.1.4, 2.1.2, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.1.4, 4.2.2, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.1.4, 2.1.2, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.1.4, 4.2.2, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.1.4, 2.1.2, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.1.4, 4.2.2, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.1.4, 2.1.2, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.1.4, 4.2.2, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.1.4, 2.1.2, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 4.1.1, 4.1.2, 4.1.4, 4.2.2, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 15                | 15                   | 50             | 20             | -                 | -               | 100     |
| CAT2                                                         | 15                | 15                   | 50             | 20             | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 15                | 15                   | 50             | 20             | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 15                | 15                   | 50             | 20             | -                 | -               | 100     |
| ESE                                                          | 15                | 15                   | 50             | 20             | -                 | -               | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|          |                                        |             |
|----------|----------------------------------------|-------------|
| 22NPC411 | ANALOG AND DIGITAL CIRCUITS LABORATORY | SEMESTER IV |
|----------|----------------------------------------|-------------|

| PREREQUISITES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                  | CATEGORY | L | T | P | C   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|----------|---|---|---|-----|
| <ul style="list-style-type: none"><li>ELECTRONICS FOR ANALOG SIGNAL PROCESSING</li><li>DIGITAL ELECTRONICS</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                  | PC       | 0 | 0 | 3 | 1.5 |
| COURSE OBJECTIVE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | To provide hands on experience on working with analog and digital circuit design |          |   |   |   |     |
| LIST OF EXPERIMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                  |          |   |   |   |     |
| <ol style="list-style-type: none"><li>Realization of Boolean expressions using basic and universal gates</li><li>Design and implementation of combinational circuits</li><li>Design and implementation of flip flops using logic gates</li><li>Design and Implementation of registers</li><li>Design and Implementation of counters</li><li>Design and Implementation of synchronous sequential circuit</li><li>Design and Implementation of mathematical operations using operational amplifier</li><li>Design of Instrumentation amplifier</li><li>Implementation of voltage and current regulators</li><li>Realization of a stable multivibrator using 555 Timer</li><li>Design and implementation of active filters</li><li>Design and Implementation of ADC and DAC</li><li>Design and Implementation of Oscillators using Opamp</li><li>Simulation of circuits using software tools</li></ol> |                                                                                  |          |   |   |   |     |
| Contact Periods: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                  |          |   |   |   |     |
| Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                  |          |   |   |   |     |

| COURSE OUTCOMES                                             |                                                             | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|-------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                             |                         |
| CO1                                                         | Use basic gates to build combinational circuits             | K4                      |
| CO2                                                         | Design different types of counter circuits using flip flops | K4                      |
| CO3                                                         | Design Op-amp based application circuits                    | K4                      |
| CO4                                                         | Choose regulator ICs as per requirement                     | K2                      |
| CO5                                                         | Implement multivibrator circuits using 555 timers           | K3                      |

**COURSE ARTICULATION MATRIX**

| a) CO/PO Mapping |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs          | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1              | 2   | 2   | 2   | 2   | 2   | -   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |
| CO2              | 3   | 3   | 3   | 3   | 3   | -   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |
| CO3              | 1   | 1   | 1   | 1   | 1   | -   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |
| CO4              | 1   | 1   | 1   | 1   | 1   | -   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |
| CO5              | 2   | 2   | 2   | 2   | 2   | -   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |
| 22NPC411         | 2   | 2   | 2   | 2   | 2   | -   | -   | 1   | 2   | 1    | 1    | 1    | 3    | -    | -    |

1 – Slight, 2 – Moderate, 3 – Substantial

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| b) CO and Key Performance Indicators mapping |                                                                                                                                                                                                                                                                       |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1                                          |
| CO2                                          | 1.1.1, 1.2.1,1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3,2.4.4,3.2.3,3.4.2,4.1.2,4.1.3,4.1.4,5.1.1,5.1.2,5.2.1,8.1.1,9.1.1,9.2.2,9.2.3,9.3.1,10.1.2,10.1.3,11.3.1,12.1.2,12.3.1                                  |
| CO3                                          | 2.1.1, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1                                                                                           |
| CO4                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1                     |
| CO5                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.2.2, 3.4.1, 3.4.2,4.1.1, 4.1.2, 4.1.3, 5.1.1, 5.1.2, 5.2.1, 8.1.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1 |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                           |                    |
|-----------------|-------------------------------------------|--------------------|
| <b>22NPC412</b> | <b>VIRTUAL INSTRUMENTATION LABORATORY</b> | <b>SEMESTER IV</b> |
|-----------------|-------------------------------------------|--------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| NIL                  | PC              | 0        | 0        | 3        | 1.5      |

|                         |                                                                                           |
|-------------------------|-------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | To provide a foundation in use of virtual instrument software for real time applications. |
|-------------------------|-------------------------------------------------------------------------------------------|

**LIST OF EXPERIMENTS**

1. Creating, Editing, Developing of VI
2. Arithmetic, Logic operations using VI
3. Conversion of VI into Sub VI
4. FOR loop, While loop using VI
5. Programming Structure, Arrays, Clusters
6. Design of Controller using Control and Simulation Tools
7. Measurement of Electrical Quantities using Electric Power Tools.
8. Data Acquisition from Sensors using DAQ
9. Frequency analysis of 1st and 2nd order System using ELVIS kit
10. Modulation Techniques using DSP Embedded kit
11. Analysis of electrical circuits using multisim.
12. Measurement of Strain and Temperature using CompactRIO
13. Signal Conditioning circuits using RIO.
14. Data updation using Web Publishing Tools.

**Contact Periods: 45 Periods**

**Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods**

| <b>COURSE OUTCOMES</b>                                      |                                                                                | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                |                                |
| CO1                                                         | Exercise the simple applications using controls and function pallets.          | K1                             |
| CO2                                                         | Understand the concepts Arrays, loops, stack structures bundle functions       | K2                             |
| CO3                                                         | Design signal conditioning circuits and driver circuits for different sensors. | K4                             |
| CO4                                                         | Analyze the signals acquired by the DAQ, ELVIS and Embedded kit                | K4                             |
| CO5                                                         | Measure the industrial parameters using advanced hardwares in VI               | K3                             |

**COURSE ARTICULATION MATRIX**

**a) CO/PO Mapping**

| COs/POs         | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| CO1             | 2   | 2   | 1   | 1   | 2   | -   | -   | 1   | 2   | 1    | 1    | 1    | 2    | 1    | 1    |
| CO2             | 2   | 2   | 1   | 1   | 2   | -   | -   | 1   | 2   | 1    | 1    | 1    | 3    | 3    | 1    |
| CO3             | 2   | 2   | 1   | 2   | 2   | -   | -   | 1   | 2   | 1    | 1    | 1    | 3    | 3    | 1    |
| CO4             | 2   | 2   | 1   | 2   | 2   | -   | -   | 1   | 2   | 1    | 1    | 1    | 3    | 2    | 2    |
| CO5             | 2   | 2   | 1   | 1   | 2   | -   | -   | 1   | 2   | 1    | 1    | 1    | 2    | 2    | 2    |
| <b>22NPC412</b> | 2   | 2   | 1   | 2   | 2   | -   | -   | 1   | 2   | 1    | 1    | 1    | 3    | 3    | 2    |

1 – Slight, 2 – Moderate, 3 – Substantial

**b) CO and Key Performance Indicators mapping**

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|     |                                                                                                                                                                                                |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.1.1,1.1.2,1.4.1,2.1.1,2.1.2,2.3.2,2.4.1,2.4.2,3.1.1,3.2.1,4.3.1,5.1.1,5.1.2,5.2.1,5.2.2,8.1.1,9.1.1,9.2.2,9.2.3,9.3.1,10.1.2,10.1.3,11.3.1,12.1.2,12.3.1                                     |
| CO2 | 1.1.1,1.1.2,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.4,2.3.2,2.4.1,2.4.2,3.1.1,3.1.4,3.2.1,4.3.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2,8.1.1,9.1.1,9.2.2,9.2.3,9.3.1,10.1.2,10.1.3,11.3.1,12.1.2,12.3.1 |
| CO3 | 1.1.1,1.1.2,1.4.1,2.1.1,2.1.2,2.1.3,2.4.1,2.4.2,2.4.3,3.1.1,3.1.4,3.2.1,4.2.1,4.3.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2,8.1.1,9.1.1,9.2.2,9.2.3,9.3.1,10.1.2,10.1.3,11.3.1,12.1.2,12.3.1             |
| CO4 | 1.1.1,1.1.2,2.1.1,2.1.2,2.1.3,2.2.4,2.3.2,2.4.1,2.4.2,3.1.1,3.1.4,3.2.1,4.2.1,4.3.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2,8.1.1,9.1.1,9.2.2,9.2.3,9.3.1,10.1.2,10.1.3,11.3.1,12.1.2,12.3.1             |
| CO5 | 1.1.1,1.1.2,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.3.2,2.4.1,2.4.2,3.1.1,3.1.4,3.2.1,4.3.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2,8.1.1,9.1.1,9.2.2,9.2.3,9.3.1,10.1.2,10.1.3,11.3.1,12.1.2,12.3.1             |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                              |                   |
|-----------------|------------------------------|-------------------|
| <b>22NPC513</b> | <b>CONTROL SYSTEM DESIGN</b> | <b>SEMESTER V</b> |
|-----------------|------------------------------|-------------------|

| PREREQUISITES                                                                  | CATEGORY | L | T | P | C |
|--------------------------------------------------------------------------------|----------|---|---|---|---|
| 22NPC301-ELECTRICAL CIRCUITS AND NETWORKS<br>22NPC303- SENSORS AND TRANSDUCERS | PC       | 3 | 1 | 0 | 4 |

|                         |                                                                                                                                                                                                                                                                           |  |  |  |  |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| <b>COURSE OBJECTIVE</b> | To inculcate the necessary knowledge of system representation, transfer function derivation for a model, and to develop time domain and frequency domain analysis using root locus, bode plot, polar plot, Nyquist plot and design compensators for a given requirements. |  |  |  |  |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|

|                 |                            |                     |
|-----------------|----------------------------|---------------------|
| <b>UNIT - I</b> | <b>MODELING OF SYSTEMS</b> | <b>9 +3 Periods</b> |
|-----------------|----------------------------|---------------------|

Basic components of control systems-classification of control systems- feedback and its effects-mathematical modeling of a system-Transfer function of mechanical (translational and rotational), Electrical, Thermal, electro-mechanical systems (AC, DC motors)-Block Diagram reduction technique and Signal flow graphs.

|                  |                                            |                     |
|------------------|--------------------------------------------|---------------------|
| <b>UNIT - II</b> | <b>TRANSIENT AND STEADY STATE ANALYSIS</b> | <b>9 +3 Periods</b> |
|------------------|--------------------------------------------|---------------------|

Test signals for time response of control systems-Type and Order of systems-Time response of first order and second order systems (under damping, critical, over damping) - Time domain specifications - Steady state error analysis.

|                   |                                                        |                     |
|-------------------|--------------------------------------------------------|---------------------|
| <b>UNIT - III</b> | <b>STABILITY ANALYSIS IN TIME AND FREQUENCY DOMAIN</b> | <b>9 +3 Periods</b> |
|-------------------|--------------------------------------------------------|---------------------|

BIBO Stability – Determining the stability by Routh-Hurwitz criterion-Properties and construction of the root loci-effect of adding poles and zeros to a system.  
Relative stability: gain margin and phase margin-stability analysis with Bode plots -polar plots-constant M and N circles- Nyquist stability criterion-Nichols chart.

|                  |                            |                     |
|------------------|----------------------------|---------------------|
| <b>UNIT - IV</b> | <b>COMPENSATORS DESIGN</b> | <b>9 +3 Periods</b> |
|------------------|----------------------------|---------------------|

Design specifications- compensator configuration (series and feedback)-design of cascade compensators (lag, lead, lag-lead) using bode plot-PID controllers.

|                 |                                   |                     |
|-----------------|-----------------------------------|---------------------|
| <b>UNIT - V</b> | <b>STATE SPACE REPRESENTATION</b> | <b>9 +3 Periods</b> |
|-----------------|-----------------------------------|---------------------|

Concepts of State, State variable and State space model – Introduction – State space representation of linear continuous time systems using physical variables, phase variables and canonical variables-diagonalization -Solution of state model – State transition matrix – Controllability and Observability.

**Contact Periods: 60 Periods**

**Lecture: 45 Periods    Tutorial: 15 Periods    Practical: 0 Periods    Total: 60 Periods**

**TEXT BOOKS:**

|   |                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>I.J. Nagarath and M.Gopal, "Control Systems Engineering", New Age International (P) Ltd., Publishers, 4<sup>th</sup> Edition, 2017.</i> |
| 2 | <i>Benjamin C.Kuo, "Automatic Control Systems", PHI Learning Private Ltd, 7<sup>th</sup> edition, 2014</i>                                 |

**REFERENCES:**

|   |                                                                                                                                   |
|---|-----------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Norman S. Nise, "Control System Engineering", John Wiley &amp; Sons, 6<sup>th</sup> Edition, 2018.</i>                         |
| 2 | <i>Katsuhiko Ogata, "Modern Control Engineering", Pearson Education, 5<sup>th</sup> Edition, 2010.</i>                            |
| 3 | <i>Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Pearson Education Pvt. Ltd., 4<sup>th</sup> Edition, 2010.</i> |
| 4 | <i>M.Gopal, "Digital Control and State Variable Methods", Tata McGraw-Hill, 4<sup>th</sup> edition, 2017.</i>                     |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                                                              | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Determine the transfer function of linear, time-invariant mechanical and electrical systems from the differential equations. | K2                                     |
| CO2                                                                                   | Perform transient and steady-state analysis of a given system.                                                               | K3                                     |
| CO3                                                                                   | Analyze the stability of the system in time and frequency domain.                                                            | K4                                     |
| CO4                                                                                   | Design compensators using frequency domain plots.                                                                            | K4                                     |
| CO5                                                                                   | Represent the system in state space form.                                                                                    | K2                                     |

## COURSE ARTICULATION MATRIX

### a)CO/PO Mapping

| COs/POs         | PO1      | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
|-----------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO1             | 3        | 2        | 2        | 2        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 2        | 1        |
| CO2             | 3        | 2        | 2        | 2        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 2        | 1        |
| CO3             | 3        | 2        | 2        | 2        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 2        | 1        |
| CO4             | 3        | 2        | 2        | 2        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 2        | 1        |
| CO5             | 3        | 2        | 2        | 2        | -        | -        | -        | -        | -        | -        | -        | 1        | 1        | 2        | 1        |
| <b>22NPC513</b> | <b>3</b> | <b>2</b> | <b>2</b> | <b>2</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>1</b> | <b>2</b> | <b>1</b> |

### b)CO and Key Performance Indicators mapping

|     |                                                                                                                    |
|-----|--------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.1.1,1.2.1,1.3.1,2.1.2,2.2.1,2.3.1,2.4.1,2.4.4,3.1.6,3.3.1,4.1.2,4.1.3,4.1.4,4.3.4,12.3.1.                        |
| CO2 | 1.1.1,1.2.1,1.3.1,2.1.2,2.2.1,2.3.1,2.4.1,2.4.4,3.1.6,3.3.1,4.1.2,4.1.2.4.2,3,4.1.4,4.3.4,12.3.1.                  |
| CO3 | 1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.2.1,2.2.1.3,3.1,2.4.1,2.4.4,3.1.6,3.3.1,4.1.2,4.1.2.4.2,3,4.1.4,4.3.4,12.3.1       |
| CO4 | 1.1.1,1.1.2,1.2.1,1.3.1,2.1.2,2.2.1,2.1.3,2.3.1,2.4.1,2.4.4,3.1.6,3.2.1,3.3.1,4.1.2,4.1.2.4.2,3,4.1.4,4.3.4,12.3.1 |
| CO5 | 1.1.1,1.2.1,1.3.1,2.1.3,2.3.1,2.4.4,3.1.6,3.3.1,3.1.5,4.1.2,4.1.3,4.1.4,4.3.4,12.3.1                               |

### ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 20                   | 40             | 30              |                   |                 | 100     |
| CAT2                                                         | 10                | 20                   | 40             | 30              |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   |                      | 50             | 50              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   |                      | 50             | 50              |                   |                 | 100     |
| ESE                                                          | 10                | 20                   | 40             | 30              |                   |                 | 100     |

|                 |                                                  |                   |
|-----------------|--------------------------------------------------|-------------------|
| <b>22NPC514</b> | <b>FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING</b> | <b>SEMESTER V</b> |
|-----------------|--------------------------------------------------|-------------------|

| <b>PREREQUISITES</b>                                 | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|------------------------------------------------------|-----------------|----------|----------|----------|----------|
| <b>22NPC410- FUNDAMENTALS OF SIGNALS AND SYSTEMS</b> | <b>PC</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                              |                                                                                                                                                               |                  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"><li>To analyze DFT techniques, design IIR and FIR digital filters and familiarize with Digital signal processors.</li></ul> |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                              | <b>DIGITAL SIGNAL PROCESSING</b>                                                                                                                              | <b>9 Periods</b> |  |
| Signal processing: Block diagram, advantages and applications - Linear and circular convolution - convolution techniques for long duration sequence (Overlap-add, Overlap-save method) - autocorrelation and cross correlation.                                                                              |                                                                                                                                                               |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                             | <b>DISCRETE FOURIER TRANSFORM</b>                                                                                                                             | <b>9 Periods</b> |  |
| Review of Fourier Series - Discrete Time Fourier Transform - properties, frequency response - Fast Fourier Transform: radix -2 DFT- Decimation In Time (DIT) FFT – Decimation In Frequency (DIF) FFT- Inverse DFT using FFT.                                                                                 |                                                                                                                                                               |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                            | <b>DESIGN OF IIR FILTERS</b>                                                                                                                                  | <b>9 Periods</b> |  |
| Introduction to Infinite Impulse Response filter - Butterworth, Chebyshev approximation - Design of analog prototype filters, Analog frequency transformations, Analog prototype to digital transformations - Impulse invariance method, Bilinear transformation - Difficulties in direct IIR filter design. |                                                                                                                                                               |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                             | <b>FIR FILTER DESIGN</b>                                                                                                                                      | <b>9 Periods</b> |  |
| Symmetric and Anti-symmetric FIR filters – Linear phase FIR filters – FIR filter Design using window method: Rectangular, Hamming and Hanning windows – Frequency sampling method – comparison of FIR and IIR filters.                                                                                       |                                                                                                                                                               |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                              | <b>DSP PROCESSORS</b>                                                                                                                                         | <b>9 Periods</b> |  |
| Architectures of DSP processing – Harvard architecture and pipelining, interrupts. Addressing modes and programming of DSP processors. Special purpose hardware – digital filters and FFT processors, Evaluation boards for real-time DSP.                                                                   |                                                                                                                                                               |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                           |                                                                                                                                                               |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                         |                                                                                                                                                               |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Proakis, J.G., &amp; Manolakis, D.G., "Digital Signal Processing: Principles and Algorithms, &amp; Applications" Prentice Hall of India, 3<sup>rd</sup> edition, 2007</i> |
| 2 | <i>P. Ramesh Babu &amp; R. Anandanatarajan, "Signals and System", Scitech Publications (India) Pvt Limited, 7<sup>th</sup> edition, 2007.</i>                                |

**REFERENCES:**

|   |                                                                                                                                                      |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Chen, C.T. "Digital Signal Processing: Spectral Computation &amp; Filter Design" Oxford Univ. Press, 4<sup>th</sup> edition, 2001</i>             |
| 2 | <i>S.K. Mitra, "Digital Signal Processing, A Computer Based Approach", Tata McGrawHill, 4<sup>th</sup> edition, 2011.</i>                            |
| 3 | <i>Steven Smith. "The Scientist and Engineer's Guide to Digital Signal Processing" California technical publishing, 3<sup>rd</sup> edition, 2001</i> |
| 4 | <i>Allan V. Oppenheim, S. Wilsky and S.H. Nawab, "Digital Signal processing", Pearson Education, 3<sup>rd</sup> edition, 2007.</i>                   |

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|   |                                                                                                                                                      |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5 | Lonnie C.Ludeman, "Fundamentals of Digital Signal Processing", Wiley, 7 <sup>th</sup> edition, 2013                                                  |
| 6 | B. Venatarakmani, M. Bhaskar, "Digital Signal Processor Architecture, Programming and Applications", Tata McGrawHill, 2 <sup>nd</sup> Edition, 2011. |

| <b>COURSE OUTCOMES</b>                                      |                                                                                     | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                     |                                |
| CO1                                                         | Apply the convolution and correlation techniques for processing the digital signals | K3                             |
| CO2                                                         | Analyze discrete-time signals and systems using DFT and FFT                         | K4                             |
| CO3                                                         | Design analog and digital IIR Filters.                                              | K4                             |
| CO4                                                         | Design analog and digital FIR Filters using window functions.                       | K4                             |
| CO5                                                         | Explain the features of the digital signal processor for real-time applications     | K2                             |

**COURSE ARTICULATION MATRIX**

| <b>a)CO/PO Mapping</b>                             |                                                                                                                                                             |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                            | PO1                                                                                                                                                         | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                | 3                                                                                                                                                           | 3   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | -    |
| CO2                                                | 3                                                                                                                                                           | 3   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | -    |
| CO3                                                | 3                                                                                                                                                           | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | -    |
| CO4                                                | 3                                                                                                                                                           | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | -    |
| CO5                                                | 2                                                                                                                                                           | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | -    |
| <b>22NPC514</b>                                    | 3                                                                                                                                                           | 3   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | -    |
| <b>b)CO and Key Performance Indicators mapping</b> |                                                                                                                                                             |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.2.3,4.3.3                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.2.3,4.3.3                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,3.1.3,3.2.2,3.2.3,3.1.4,4.3.3,4.3.3                   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.3,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,4.3.3,4.3.4 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                | 1.1.2,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,3.1.3                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         |                   | 20                   | 50             | 30              |                   |                 | 100     |
| CAT2                                                         |                   | 30                   | 40             | 30              |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   |                      | 50             | 50              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   |                      | 50             | 50              |                   |                 | 100     |
| ESE                                                          |                   | 30                   | 50             | 20              |                   |                 | 100     |

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|                 |                                                          |                   |
|-----------------|----------------------------------------------------------|-------------------|
| <b>22NPC515</b> | <b>MICROPROCESSORS, MICROCONTROLLERS AND INTERFACING</b> | <b>SEMESTER V</b> |
|-----------------|----------------------------------------------------------|-------------------|

| PREREQUISITES                       | CATEGORY  | L        | T        | P        | C        |
|-------------------------------------|-----------|----------|----------|----------|----------|
| <b>22NPC408 DIGITAL ELECTRONICS</b> | <b>PC</b> | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                         |                                                                                                              |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                 | To introduce the fundamental concepts, interfacing and applications of microprocessors and microcontrollers. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                         | <b>8085 AND 8086 MICROPROCESSORS</b>                                                                         | <b>9 Periods</b> |  |
| 8085 : Architecture , Instruction Set - 8086 : Basic Concepts, Architecture : Bus Interface Unit, Execution unit - Pin configuration - Minimum mode and Maximum mode configuration - Instruction set - Addressing modes - Interrupts - Assembly language programming                                                                                    |                                                                                                              |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                        | <b>8051 MICROCONTROLLER</b>                                                                                  | <b>9 Periods</b> |  |
| 8051 Microcontroller : Architecture , Instruction Set , Addressing Modes , Interrupts - Assembly Language Programming : Programming 8051 Timers, Serial Port Programming, Interrupts Programming.                                                                                                                                                       |                                                                                                              |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                       | <b>PERIPHERAL INTERFACING AND COMMUNICATION INTERFACES</b>                                                   | <b>9 Periods</b> |  |
| Programmable Interrupt Controller 8259, Programmable Communication Interface 8251, Programmable Interval Timer 8253, DMA Interface 8237, ADC, DAC, LCD , Keyboard , External Memory Interfacing , Stepper Motor Control , Traffic Light Control, Washing Machine Control, Serial Communication Interfaces : RS232, RS485, I <sup>2</sup> C SPI and USB. |                                                                                                              |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                        | <b>PIC MICROCONTROLLER</b>                                                                                   | <b>9 Periods</b> |  |
| PIC Microcontroller : Architecture , Instruction set ,Timers, Interrupts, Serial Ports, Assembly Language Programming : Input / Output Port Programming – PIC Programming in C                                                                                                                                                                          |                                                                                                              |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                         | <b>AVR MICROCONTROLLER</b>                                                                                   | <b>9 Periods</b> |  |
| Overview of AVR Microcontroller family - ATmega 32 : Architecture, Pin Configuration , General Purpose Register, AVR Status Register, Addressing Modes , Instructions: Branch, Call, Time Delay Loop, Arithmetic and Logical - ARM Processor : Basic Concepts, Architecture                                                                             |                                                                                                              |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                      |                                                                                                              |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                    |                                                                                                              |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Deshmhmukh L M, “Microcontrollers (Theory and applications)”, McGraw-Hill, 7<sup>th</sup> Edition, 2008</i>                                 |
| 2 | <i>Rajkamal “Microcontrollers (Architecture, programming, interfacing and system design)”, Pearson Education, 2<sup>nd</sup> Edition, 2011</i> |

**REFERENCES:**

|   |                                                                                                                                                                           |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D.McKinlay “The 8051 Microcontroller and Embedded Systems” Pearson Education, 2<sup>nd</sup> Edition ,2008.</i> |
| 2 | <i>Ramesh. S. Gaonkar, “Microprocessor Architecture, Programming and Applications of 8085”, Penram International, 6<sup>th</sup> Edition, 2013</i>                        |
| 3 | <i>Sunil Mathur, “Microprocessor 8086: Architecture, Programming and Interfacing” , PHI, 1<sup>st</sup> Edition, 2010</i>                                                 |
| 4 | <i>Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, “AVR Microcontroller and Embedded Systems”, Pearson Education, 1<sup>st</sup> Edition, 2013</i>                       |

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| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                                     | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Explain the architecture of 8085 & 8086 microprocessor, instruction set and peripheral interfacing. | K2                                     |
| CO2                                                                                   | Elucidate the architecture and instructions of 8051 microcontroller.                                | K2                                     |
| CO3                                                                                   | Interface peripheral devices with 8051 microcontroller                                              | K3                                     |
| CO4                                                                                   | Develop program using PIC microcontroller                                                           | K3                                     |
| CO5                                                                                   | Describe the architecture and instructions of AVR microcontroller & ARM processor.                  | K2                                     |

### COURSE ARTICULATION MATRIX

| <b>a)CO/PO Mapping</b>                             |                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------------|---------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                            | PO1                                                           | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| CO2                                                | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| CO3                                                | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| CO4                                                | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| CO5                                                | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| <b>22NPC515</b>                                    | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| <b>b)CO and Key Performance Indicators mapping</b> |                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                | 60                   | 20             |                |                   |                 | 100     |
| CAT2                                                         | 20                | 60                   | 20             |                |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 40                   | 40             |                |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 40                   | 40             |                |                   |                 | 100     |
| ESE                                                          | 20                | 60                   | 20             |                |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| 22NPC516                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                      | PRINCIPLES OF COMMUNICATION SYSTEMS |   | SEMESTER V |           |   |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------|---|------------|-----------|---|--|
| PREREQUISITES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                      | CATEGORY                            | L | T          | P         | C |  |
| 1. 22NPC302 ANALOG ELECTRONICS<br>2. 22NPC407 ELECTRONICS FOR ANALOG SIGNAL PROCESSING<br>3. 22NPC408 DIGITAL ELECTRONICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                      | PC                                  | 3 | 0          | 0         | 3 |  |
| COURSE OBJECTIVE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | To impart knowledge in analog and digital modulation techniques with different communication systems |                                     |   |            |           |   |  |
| UNIT - I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | AMPLITUDE MODULATION                                                                                 |                                     |   |            | 9 Periods |   |  |
| Modulation – Need for Modulation. Basic principle of AM – Modulation Index - Frequency spectrum – Power relations – AM modulators: Diode, Transistor, Differential amplifier and Collector modulators - AM Demodulators: Diode detector, Synchronous detector with carrier recovery circuits– Suppressed Carrier systems: DSBSC, SSBSC - Generation and detection of DSBSC: Balanced modulators, Lattice modulators – Single Sideband Transmitters: Filter method, Phase shift method – Vestigial Sideband – AM transmitters: Low level and High level - AM Receivers: TRF receiver, Superheterodyne receiver. |                                                                                                      |                                     |   |            |           |   |  |
| UNIT - II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | ANGLE MODULATION                                                                                     |                                     |   |            | 9 Periods |   |  |
| Definition of FM and PM – Single tone – Narrow band – Wide band – Multi tone FM – FM Generation: Direct method using basic reactance modulator, diode modulator, crystal oscillator, voltage controlled oscillator modulator and indirect method. FM detection: Slope detectors, Pulse averaging detectors, PLL as FM detector – FM transmitters and receivers – Frequency versus Phase modulation.                                                                                                                                                                                                            |                                                                                                      |                                     |   |            |           |   |  |
| UNIT - III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | EFFECT OF NOISE                                                                                      |                                     |   |            | 9 Periods |   |  |
| Noise-Source and Classification: External and Internal Noise - Noise voltage - Correlated and impulse noise - Interference - SNR - Noise factor - Noise Figure - Noise Temperature – Noise in AM system using envelope detector - Noise Limiters and blankers. FM receivers – Noise in FM reception – FM threshold effect – Pre-emphasis and de-emphasis.                                                                                                                                                                                                                                                      |                                                                                                      |                                     |   |            |           |   |  |
| UNIT - IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | PULSE MODULATION                                                                                     |                                     |   |            | 9 Periods |   |  |
| Pulse Modulation: Sampling – Quantization – Time Division Multiplexing – Frequency Division Multiplexing – PAM – PWM – PCM – Delta Modulation PCM – Adaptive Delta Modulation – Differential PCM.                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                      |                                     |   |            |           |   |  |
| UNIT - V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | DIGITAL MODULATION                                                                                   |                                     |   |            | 9 Periods |   |  |
| Measure of Information - Entropy - Source coding theorem - Information and Channel capacity - Shannon Hartley Law - Transform coding –Shannon-Fano coding, Huffman Coding, Run length coding, LZW algorithm - Channel coding theorem – Linear block codes – Hamming codes – Cyclic codes. Digital Communication: Transmitter, receiver and bandwidth of ASK, FSK, PSK and QAM. Introduction to Spread Spectrum: Signals, types, Advantages, Applications                                                                                                                                                       |                                                                                                      |                                     |   |            |           |   |  |
| Contact Periods: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                      |                                     |   |            |           |   |  |
| Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                      |                                     |   |            |           |   |  |

**TEXT BOOKS:**

|   |                                                                                                                        |
|---|------------------------------------------------------------------------------------------------------------------------|
| 1 | S.Haykins, “ <i>Communication Systems</i> ”, John Wiley Inc, 5 <sup>th</sup> Edition, 2009.                            |
| 2 | J.S.Beasley & G.M.Miler, “ <i>Modern Electronic Communication</i> ”, Pearson Education, 9 <sup>th</sup> Edition, 2013. |

**REFERENCES:**

|   |                                                                                                                                              |
|---|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | H. Taub & D. Schilling, “ <i>Principles of Communication System</i> ”, Tata McGraw Hill, 4 <sup>th</sup> Edition, 2017.                      |
| 2 | G.Kennedy, “ <i>Electronic Communication Systems</i> ”, Tata McGraw-Hill, 4 <sup>th</sup> Edition, 2017.                                     |
| 3 | B.P. Lathi and Zhi Ding, “ <i>Modern Digital and Analog Communication Systems</i> ”, Oxford University Press, 5 <sup>th</sup> Edition, 2022. |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|   |                                                                                                                               |
|---|-------------------------------------------------------------------------------------------------------------------------------|
| 4 | Louis E. Frenzel, " <i>Principles of Electronic Communication Systems</i> ", Tata McGraw-Hill, 4 <sup>th</sup> Edition, 2016. |
| 5 | R.Blake, " <i>Electronic Communication Systems</i> ", Thomson Delmar, 2 <sup>nd</sup> Edition, 2012.                          |
| 6 | Dennis Roddy and John Coolen, " <i>Electronic Communications</i> ", Pearson Education, 4 <sup>th</sup> Edition, 2008.         |

| COURSE OUTCOMES                                             |                                                                                   | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                                   |                         |
| CO1                                                         | Explain the generation and detection involved in amplitude modulation.            | K3                      |
| CO2                                                         | Describe the different angle modulation techniques, its generation and detection. | K3                      |
| CO3                                                         | Compare the effect of noise in AM and FM modulation techniques                    | K2                      |
| CO4                                                         | Elucidate about the concepts of sampling and pulse modulation schemes             | K2                      |
| CO5                                                         | Explain the digital modulation schemes and compare their performance.             | K2                      |

## COURSE ARTICULATION MATRIX

### a)CO/PO Mapping

| COs/POs  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| CO1      | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| CO2      | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| CO3      | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| CO4      | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| CO5      | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |
| 22NPC516 | 3   | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 1    | 1    |

### b)CO and Key Performance Indicators mapping

|     |                                                                             |
|-----|-----------------------------------------------------------------------------|
| CO1 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6 |
| CO2 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6 |
| CO3 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6 |
| CO4 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6 |
| CO5 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6 |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project 1 | 20                | 40                   | 40             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 40                   | 40             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 60                   | 20             |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|          |                                      |            |
|----------|--------------------------------------|------------|
| 22NPC517 | INDUSTRIAL HYDRAULICS AND PNEUMATICS | SEMESTER V |
|----------|--------------------------------------|------------|

| PREREQUISITES                                 | CATEGORY | L | T | P | C |
|-----------------------------------------------|----------|---|---|---|---|
| 22NES306 - THERMODYNAMICS AND FLUID MECHANICS | PC       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                   |                                                                                                            |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                           | To provide exposure to the basics of hydraulic and pneumatic circuits for various engineering applications |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                   | <b>FLUID POWER PRINCIPLES</b>                                                                              | <b>9 Periods</b> |  |
| Introduction to fluid power – Advantages and Applications – Types of fluids – Properties of fluids - Hydraulic power symbols (ANSI and ISO) – Pascal’s Law, Gas law, Principles of flow, work, power and torque. Applications of Pascal’s Law-Losses in pipe, valves and fittings.                                |                                                                                                            |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                  | <b>HYDRAULIC SYSTEM COMPONENTS</b>                                                                         | <b>9 Periods</b> |  |
| Pumping Theory – Pump Classification – Fixed and Variable displacement Pumps: Working, Advantages, Disadvantages and Performances. Hydraulic Actuators: Motors, Cylinders, Types and Construction– Performance charts. Control Valves: Direction, Flow and Pressure Control Valves– Accumulator and Intensifiers. |                                                                                                            |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                 | <b>CONTROL OF HYDRAULIC SYSTEMS</b>                                                                        | <b>9 Periods</b> |  |
| Reciprocating- Sequencing – Synchronizing – Regenerative – Pump Unloading – Double Pump Circuits – Counterbalance valve application circuit - Fail-Safe circuits- Hydrostatic Transmission-Hydraulic power pack; Installation, Maintenance and Troubleshooting of Hydraulic circuits.                             |                                                                                                            |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                  | <b>PNEUMATIC SYSTEMS</b>                                                                                   | <b>9 Periods</b> |  |
| Compressors – Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Pressure sensing devices, Pressure switches- Pneumatic Symbols(ANSI and ISO) – Introduction to Fluidics – Pneumatic logic circuits : AND,OR, Memory, Flip flops.                             |                                                                                                            |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                   | <b>DESIGN AND SELECTION OF PNEUMATIC CIRCUITS</b>                                                          | <b>9 Periods</b> |  |
| Sequential circuits – Design for simple applications using Classic, Cascade, Step counter, Combination methods– Electro-pneumatic circuits –Low cost Automation – Pneumatic Power Packs – Installation, Fault finding and Maintenance of pneumatic systems.                                                       |                                                                                                            |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                |                                                                                                            |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                              |                                                                                                            |                  |  |

**TEXT BOOKS:**

|   |                                                                                                             |
|---|-------------------------------------------------------------------------------------------------------------|
| 1 | Anthony Esposito “ <i>Fluid Power with Applications</i> ”, Pearson education, 7 <sup>th</sup> edition, 2014 |
| 2 | Andrew Parr “ <i>Hydraulics &amp; Pneumatics</i> ”, Jaico Publishing House, 3 <sup>rd</sup> edition, 2011.  |

**REFERENCES:**

|   |                                                                                                                           |
|---|---------------------------------------------------------------------------------------------------------------------------|
| 1 | Petor Rohner, “ <i>Fluid power logic circuit Design</i> ”, Macmillon Press Ltd, 3 <sup>rd</sup> edition, 2010             |
| 2 | Harry L. Stevart D.B “ <i>Practical guide to fluid power</i> ” Taraoeala sons and Port Ltd, 5 <sup>th</sup> edition, 2016 |
| 3 | Dudelyt, A. Pease John T. Pippenger “ <i>Basic Fluid Power</i> ” Prentice Hall, 2 <sup>nd</sup> edition, 2017             |
| 4 | Michael J, Prinches and Ashby J. G, “ <i>Power Hydraulics</i> ”, Prentice Hall, 4 <sup>th</sup> edition, 2009             |

| COURSE OUTCOMES                                             |                                                                                               | Bloom’s Taxonomy Mapped |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                                               |                         |
| CO1                                                         | Enlist the properties, laws and symbols used in fluid power systems.                          | K1                      |
| CO2                                                         | Explain the Construction and working principles of Hydraulic components for Industrial needs. | K2                      |

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|     |                                                                                                                                      |    |
|-----|--------------------------------------------------------------------------------------------------------------------------------------|----|
| CO3 | Design the hydraulic circuits by selecting proper components for a given application.                                                | K3 |
| CO4 | Describe the Construction and working principles of Pneumatic components                                                             | K2 |
| CO5 | Design the pneumatic circuits by selecting proper components and Apply the Maintenance procedures of Hydraulic and Pneumatic systems | K3 |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping                             |                                                                                                                         |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                      | PO1                                                                                                                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                          | 3                                                                                                                       | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| CO2                                          | 2                                                                                                                       | 3   | -   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| CO3                                          | 3                                                                                                                       | 3   | 1   | -   | -   | 2   | -   | -   | -   | -    | -    | -    | 1    | 2    | 3    |
| CO4                                          | 3                                                                                                                       | 2   | 1   | 1   | -   | 1   | -   | -   | -   | -    | -    | -    | 1    | 3    | 2    |
| CO5                                          | 3                                                                                                                       | 2   | 1   | -   | -   | 1   | -   | -   | -   | -    | -    | -    | 1    | 3    | 2    |
| 22NPC517                                     | 3                                                                                                                       | 3   | 1   | 1   | -   | 1   | -   | -   | -   | -    | -    | -    | 1    | 3    | 2    |
| b) CO and Key Performance Indicators mapping |                                                                                                                         |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                          | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.3,2.3.1,2.3.2,2.4.1,3.1.4,3.2.3                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                          | 1.1.1,1.2.1,1.3.1,2.1.1,2.1.2,2.1.3,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.4,4.1.3                                           |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                          | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,3.1.5,3.2.3,3.4.2,6.1.1,6.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                          | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.4,2.3.1,2.4.1,3.1.4,4.1.3,6.1.1                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                          | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.4,2.3.1,3.1.5,3.2.3,6.1.1                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 30                   | 50             |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 30                   | 50             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 40                   | 60             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 40                   | 60             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 30                   | 50             |                 |                   |                 | 100     |

|                 |                                         |                   |
|-----------------|-----------------------------------------|-------------------|
| <b>22NPC518</b> | <b>CONTROL SYSTEM DESIGN LABORATORY</b> | <b>SEMESTER V</b> |
|-----------------|-----------------------------------------|-------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|----------------------|-----------------|----------|----------|----------|------------|
| <b>NIL</b>           | <b>PC</b>       | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |

|                         |                                                                                                                        |
|-------------------------|------------------------------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | To impart knowledge in classical control and state-space control system design with hardware and software integration. |
|-------------------------|------------------------------------------------------------------------------------------------------------------------|

**LIST OF EXPERIMENTS**

1. Modeling of DC motor via Step test (Determination of Transfer function for Rotary Inverted Pendulum).
2. Steady state analysis of first and second order systems for various standard inputs.
3. Time response analysis of first and second order systems
4. Stability analysis of servo systems (Rotary Inverted Pendulum) via software and hardware integration.
5. Frequency response analysis using Bode Plot and Polar plot
6. Stability Analysis using Frequency Plot (Bode).
7. Stability Analysis using Time Domain Plot (Root locus, Routh-Hurwitz criterion).
8. Frequency response of Lead,lag compensators (Hardware Realization).
9. Design and simulation of compensation networks - Lead, Lag, Lead-lag using bode plots.
10. Performance analysis of P, PI, PD and PID controllers for first order, first order systems with deadtime and second order systems.
11. Design and simulation of Linear systems.
12. Determination of Controllability and Observability using State space Model & Conversion of Transfer function to State space model.

**Contact Periods: 45 Periods****Lecture: 0 Periods    Tutorial: 0 Periods    Practical: 45 Periods    Total: 45 Periods**

| <b>COURSE OUTCOMES</b>                                      |                                                                                      | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to |                                                                                      |                                |
| CO1                                                         | Develop mathematical model for DC motor                                              | K3                             |
| CO2                                                         | Analyze the response and stability of simple systems using modern engineering tools. | K3                             |
| CO3                                                         | Interpret the results of the response and prioritize the inferences.                 | K3                             |
| CO4                                                         | Design Compensators for given specification.                                         | K3                             |
| CO5                                                         | Differentiate the response obtained for various input standards                      | K2                             |

### a) CO/PO Mapping

| b) CO and Key Performance Indicators mapping |                                                                                                                                                                                                                                                                 |
|----------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1                                           |
| CO2                                          | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.2.3, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1               |
| CO3                                          | 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1                                                                       |
| CO4                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.2.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1                      |
| CO5                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.2.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 5.1.1, 5.1.2, 5.2.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1 |

|     |                                                                                                                                                                                                                                                                 |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1                                           |
| CO2 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.2.3, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1               |
| CO3 | 1.2.1, 1.3.1, 2.1.1, 2.1.3, 2.2.2, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.1.2, 5.2.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1                                                                       |
| CO4 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 5.2.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1                      |
| CO5 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.2.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 5.1.1, 5.1.2, 5.2.1, 9.1.1, 9.2.2, 9.2.3, 9.3.1, 10.1.2, 10.1.3, 11.3.1, 12.1.2, 12.3.1 |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                              |                                                                 |            |  |   |   |   |     |
|------------------------------|-----------------------------------------------------------------|------------|--|---|---|---|-----|
| 22NPC519                     | MICROPROCESSORS, MICROCONTROLLERS<br>AND INTERFACING LABORATORY | SEMESTER V |  |   |   |   |     |
| PREREQUISITES                |                                                                 | CATEGORY   |  | L | T | P | C   |
| 22NPC408 DIGITAL ELECTRONICS |                                                                 | PC         |  | 0 | 0 | 3 | 1.5 |

|                         |                                                                                                |
|-------------------------|------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | To provide hands on experience on working with microprocessor and microcontroller trainer kits |
|-------------------------|------------------------------------------------------------------------------------------------|

**LIST OF EXPERIMENTS**

1. Programming using Arithmetic, Logical instructions of 8085 microprocessor
2. Programming using Arithmetic, Logical and Bit manipulation instructions of 8051 / PIC microcontroller
3. Programming using arithmetic, logical, string instructions of 8086
4. Interfacing of ADC / DAC/ External Memory with  $\mu p / \mu c$
5. Interfacing of stepper motor with  $\mu p / \mu c$
6. Interfacing of Programmable Peripheral Interface (8255) with  $\mu p / \mu c$
7. Seven segment display interface with  $\mu p / \mu c$
8. Interfacing of Traffic Light Controller with  $\mu p / \mu c$
9. Interface of display/keyboard with  $\mu p / \mu c$
10. Programming exercises using Timer 8253
11. Programming exercises using Interrupt Controller 8259
12. Interfacing of Sensors with  $\mu p / \mu c$

**Contact Periods: 45 Periods**

**Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods**

| <b>COURSE OUTCOMES</b>                                      |                                                                              | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to |                                                                              |                                |
| CO1                                                         | Discuss the basic concepts of microprocessor and microcontroller             | K2                             |
| CO2                                                         | Develop assembly language program using microprocessor/ microcontroller kit  | K3                             |
| CO3                                                         | Interface the different peripherals with Microprocessor / microcontroller    | K3                             |
| CO4                                                         | Demonstrate the use of timer / interrupt controller for a given application. | K3                             |
| CO5                                                         | Develop programs using Raspberry Pi /AT Mega 32 microcontrollers.            | K3                             |

**COURSE ARTICULATION MATRIX**

| <b>b) CO/PO Mapping</b> |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                     | 2   | 2   | 1   | 1   | 1   | -   | -   | -   | 2   | 1    | -    | 1    | 3    | -    | 1    |
| CO2                     | 2   | 2   | 1   | 1   | 1   | -   | -   | -   | 2   | 1    | -    | 1    | 3    | -    | 1    |
| CO3                     | 2   | 2   | 1   | 1   | 1   | -   | -   | -   | 2   | 1    | -    | 1    | 3    | -    | 1    |
| CO4                     | 2   | 2   | 1   | 1   | 1   | -   | -   | -   | 2   | 1    | -    | 1    | 3    | -    | 1    |
| CO5                     | 2   | 2   | 1   | 1   | 1   | -   | -   | -   | 2   | 1    | -    | 1    | 3    | -    | 1    |
| <b>22NPC519</b>         | 2   | 2   | 1   | 1   | 1   | -   | -   | -   | 2   | 1    | -    | 1    | 3    | -    | 1    |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING****b) CO and Key Performance Indicators mapping**

|     |                                                                                                                                                       |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6, 4.1.1, 4.2.1, 5.1.2, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.2, 10.1.3, 12.2.1, 12.2.2 |
| CO2 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6, 4.1.1, 4.2.1, 5.1.2, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.2, 10.1.3, 12.2.1, 12.2.2 |
| CO3 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6, 4.1.1, 4.2.1, 5.1.2, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.2, 10.1.3, 12.2.1, 12.2.2 |
| CO4 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6, 4.1.1, 4.2.1, 5.1.2, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.2, 10.1.3, 12.2.1, 12.2.2 |
| CO5 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6, 4.1.1, 4.2.1, 5.1.2, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.2, 10.1.3, 12.2.1, 12.2.2 |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                              |                   |
|-----------------|----------------------------------------------|-------------------|
| <b>22NPC520</b> | <b>INDUSTRIAL INSTRUMENTATION LABORATORY</b> | <b>SEMESTER V</b> |
|-----------------|----------------------------------------------|-------------------|

|                                            |                 |          |          |          |          |
|--------------------------------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b>                       | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>22NPC409 INDUSTRIAL INSTRUMENTATION</b> | <b>PC</b>       | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

|                         |                                                                                                                                                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | To involve students in performing experiments with a range of field instruments used in the industries by selecting appropriate tools, equipment and complying with all occupational health and safety procedures |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**LIST OF EXPERIMENTS**

1. Characteristics of pH Meter
2. Observation of Relative Humidity Using Hygrometer
3. Characteristics of I/P Convertor
4. Characteristics of P/I Convertor
5. Measurement of Flow using turbine flowmeter
6. Rotameter characterization
7. Determination of the coefficient of discharge of venturimeter
8. Determination of coefficient of discharge using orifice meter
9. Calibration of pressure gauges using dead weight tester
10. Measurement of level using DP transmitter
11. Configuration of DP Transmitter for measurement of Flow using orifice meter as a primary element.
12. Configuration of DP Transmitter for measurement of Flow using Venturi Meter as a primary element.

**Contact Periods: 30 Periods**

**Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 30 Periods      Total: 30 Periods**

| <b>COURSE OUTCOMES</b>                                      |                                                                                                                                                                          | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to |                                                                                                                                                                          |                                |
| CO1                                                         | Demonstrate the ability to characterize humidity and pH sensors individually by performing experiments                                                                   | K3                             |
| CO2                                                         | Show the skill to characterize various convertors for instrument signals by performing experiments                                                                       | K3                             |
| CO3                                                         | Exhibit competency in measuring flow rate thru pipeline using various flow measuring instruments and estimate the coefficient of discharge of orifice and venturi meters | K3                             |
| CO4                                                         | Calibrate pressure gauges and perform experiments individually to measure level and temperature                                                                          | K3                             |
| CO5                                                         | Work as a member of a team and interpret the results to draw meaningful conclusions                                                                                      | K3                             |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs          | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1              | 3   | 2   | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | 3    | 3    | 2    | 1    |
| CO2              | 3   | 2   | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | 3    | 3    | 2    | 1    |
| CO3              | 3   | 2   | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | 3    | 3    | 2    | 1    |
| CO4              | 3   | 2   | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | 3    | 3    | 2    | 1    |
| CO5              | 3   | 2   | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | 3    | 3    | 2    | 1    |
| <b>22NPC520</b>  | 3   | 2   | -   | -   | -   | -   | -   | -   | 3   | 3    | -    | 3    | 3    | 2    | 1    |

| b) CO and Key Performance Indicators mapping |                                                                                                                                                |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                          | 1.2.1., 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1., 9.1.1,9.1.2, 9.2.1 , 9.2.2, 9.2.3, 9.3.1, 10.1.1., 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, |
| CO2                                          | 1.2.1., 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1.,9.1.1,9.1.2, 9.2.1 , 9.2.2, 9.2.3, 9.3.1, 10.1.1., 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2,  |
| CO3                                          | 1.2.1., 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1., 9.1.1,9.1.2, 9.2.1 , 9.2.2, 9.2.3, 9.3.1, 10.1.1., 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, |
| CO4                                          | 1.2.1., 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1., 9.1.1,9.1.2, 9.2.1 , 9.2.2, 9.2.3, 9.3.1, 10.1.1., 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, |
| CO5                                          | 1.2.1., 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1., 9.1.1,9.1.2, 9.2.1 , 9.2.2, 9.2.3, 9.3.1, 10.1.1., 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                                    |                    |
|-----------------|------------------------------------------------------------------------------------|--------------------|
| <b>22NHS606</b> | <b>INDUSTRIAL MANAGEMENT AND ECONOMICS</b><br>(Common to EIE, CSE and IT Branches) | <b>SEMESTER VI</b> |
|-----------------|------------------------------------------------------------------------------------|--------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PC       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                            | 1. To understand the role of ergonomics in organizational setting.<br>2. To understand the important legislations that govern organizational management.<br>3. To understand the microeconomic concepts and it's impact on engineering decisions and everyday life activities.<br>4. To understand the macroeconomic concepts and it's impact on organizations and everyday life activities.<br>5. To understand the role of stock markets and taxation on individual consumers and organizations. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>INDUSTRIAL MANAGEMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>9 Periods</b> |  |
| Meaning, Scope, Importance, Evolution & growth, Need, Ergonomics – Need at Workplace, Reasons for importance, Benefits, Hazards of non-ergonomically designed workplace, Principles of ergonomics, Ergonomic Assessment Software Safety Culture – An Introduction.                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                   | <b>INTRODUCTION TO THE PROVISIONS OF LEGISLATIONS GOVERNING INDUSTRIES IN INDIA</b>                                                                                                                                                                                                                                                                                                                                                                                                                | <b>9 Periods</b> |  |
| Factories Act, Employees State Insurance Act, Workmen's Compensation Act, Sexual Harassment of women at workplace (Prevention, Prohibition & Redressal) Act.                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                  | <b>MICROECONOMICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>9 Periods</b> |  |
| Definition, Scope, Differences with macro economics, Demand – Definition, Law of Demand, Demand Schedule, Exceptions to Law of Demand, Factors affecting demand, Elasticity of demand Supply – Definition, Law of Supply, Supply Schedule, Factors affecting supply, Elasticity of Supply.                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                   | <b>MACROECONOMICS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>9 Periods</b> |  |
| Definition, Scope, Money – Evolution, Types, Functions, Reserve Bank of India – Definition, Functions – Credit control measures, Commercial banks – Definition, Need, Functions, Types of deposits, Types of loans, Inflation & Deflation – Definitions, Types, Methods of controlling inflation and deflation, Impact of inflation and deflation on different segments of people. |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>KEY ECONOMIC INDICATORS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>9 Periods</b> |  |
| Gross Domestic Product, Unemployment, Stock Market trends, Taxation.                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                  |  |

**TEXT BOOKS:**

|   |                                                                             |
|---|-----------------------------------------------------------------------------|
| 1 | Kiran U.V, "Fundamentals of Ergonomics," JTS Publications, 2020             |
| 2 | Gupta C.B, Sultan, "Management Theory and Practice," Chand and Sons, 2021   |
| 3 | Gaurav Jain, "Microeconomics," Neoblocks and Printers Private Limited, 2017 |
| 4 | Gaurav Jain, "Macroeconomics," Ajmer Graphics, 2019                         |

**REFERENCES:**

|   |                                                                                            |
|---|--------------------------------------------------------------------------------------------|
| 1 | Bridger, "Introduction to Human Factors and Ergonomics," Taylor & Francis publishers, 2017 |
| 2 | Koontz & Weihrich, "Elements of Management" McGraw Hill, 2020                              |
| 3 | Bright David, "Principles of Management," Open Stax Textbooks, 2022                        |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|   |                                                                                             |
|---|---------------------------------------------------------------------------------------------|
| 4 | Robert Pindyck & Daniel, Rubinfeld, " <i>Microeconomics</i> ," Pearson Education, 2017      |
| 5 | G.S.Gupta, " <i>Microeconomics – Theory and Applications</i> ," McGraw Hill Education, 2017 |

| <b>COURSE OUTCOMES</b>                                      |                                                                                                                                                         | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                                                                                         |                                |
| CO1                                                         | Establish ergonomical workspaces and enhance productivity.                                                                                              | K3                             |
| CO2                                                         | Implement the statutory requirements for a safe workplace.                                                                                              | K4                             |
| CO3                                                         | Understand the impact of microeconomics concepts on individual behavior.                                                                                | K2                             |
| CO4                                                         | Understand the interplay between the economics cycles, business performance and engineering decisions.                                                  | K2                             |
| CO5                                                         | Implement appropriate financial decisions that would contribute to the country's GDP and also suit the taxation policies in practice from time to time. | K4                             |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                  |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|--------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                              | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | -                                                | -   | 3   | -   | -   | 3   | 3   | -   | -   | -    | 2    | -    | -    | -    | 1    |
| CO2                                                 | -                                                | -   | -   | -   | -   | 3   | -   | 3   | 2   | -    | -    | 1    | -    | -    | 1    |
| CO3                                                 | -                                                | -   | -   | -   | -   | -   | 2   | -   | -   | -    | 3    | -    | -    | -    | 1    |
| CO4                                                 | -                                                | -   | 2   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | -    | -    | 1    |
| CO5                                                 | -                                                | -   | -   | 2   | -   | -   | -   | -   | -   | -    | 1    | -    | -    | -    | 1    |
| <b>22NHS606</b>                                     | -                                                | -   | 1   | 1   | 1   | 2   | 1   | 1   | 1   | -    | 2    | 1    | -    | -    | 1    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                  |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 3.1.3, 3.1.5, 3.4.1, 3.4.2, 6.1.1, 7.1.2, 11.2.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 6.2.1, 8.2.2, 9.1.1, 9.2.4, 12.1.2, 12.3.1       |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 7.1.1, 11.1.1, 11.2.1                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 3.3.1, 3.4.1, 5.1.2, 5.2.2, 12.3.1, 12.3.2       |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 4.3.2, 4.3.4, 11.1.1, 11.2.1                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         |                   | 20                   | 40             | 40              |                   |                 | 100     |
| CAT2                                                         |                   | 20                   | 40             | 40              |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   |                      | 50             | 50              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   |                      | 50             | 50              |                   |                 | 100     |
| ESE                                                          |                   | 20                   | 50             | 30              |                   |                 | 100     |

|                 |                                     |                    |
|-----------------|-------------------------------------|--------------------|
| <b>22NPC621</b> | <b>PROCESS DYNAMICS AND CONTROL</b> | <b>SEMESTER VI</b> |
|-----------------|-------------------------------------|--------------------|

| <b>PREREQUISITES</b>                  | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---------------------------------------|-----------------|----------|----------|----------|----------|
| <b>22NPC513-CONTROL SYSTEM DESIGN</b> | <b>PC</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                          |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                          | To familiarize with process modeling, characteristics of control valves, controller tuning and advanced process control. |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>PROCESS MODELLING</b>                                                                                                 | <b>9 Periods</b> |
| Need for process control – Hierarchical decomposition of control functions – Servo and regulatory operations – Continuous and Batch processes – Mathematical modelling: Level, Flow, Pressure and Thermal processes – Lumped and Distributed parameter models – Degrees of Freedom – Interacting and non-interacting systems – Self-regulation and non-self regulation - Inverse response – Linearization of non-linear systems. |                                                                                                                          |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>CONTROLLERS</b>                                                                                                       | <b>9 Periods</b> |
| Characteristic of ON-OFF, Single speed floating, Proportional, Integral and Derivative controllers – PI, PD and PID control modes – Practical forms of PID Controller (Electronic and Pneumatic type) –PID Implementation Issues: Auto/manual Mode transfer, Bumpless transfer, Anti-reset windup techniques and Direct/reverse action. Response of controller for error signals.                                                |                                                                                                                          |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                | <b>PID CONTROLLER TUNING</b>                                                                                             | <b>9 Periods</b> |
| PID Controller Design Specifications: Criteria based on Time Response and Frequency Response,IAE,ISE,ITAE, ¼ decay ratio - PID Controller Tuning- Open Loop Tuning: Process reaction curve, Ziegler-Nichols method, Cohen-Coon method, Lambda tuning, Internal Model Controller PID tuning method - Closed Loop Tuning: Ziegler-Nichols method, Continuous cycling method, Damped Oscillation method- Auto tuning: Relay tuning. |                                                                                                                          |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>FINAL CONTROL ELEMENT</b>                                                                                             | <b>9 Periods</b> |
| Actuators: Pneumatic types (Air to open, Air to close ) and Electric actuators – I/P converter,P/I converter – Control Valve Terminology-Control Valve Types: Linear, Quick-opening and Equal percentage – Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Valve body - Commercial valve bodies – Cavitation and Flashing– Control Valve selection-Safety Valves                   |                                                                                                                          |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>MULTI LOOP CONTROL SCHEMES AND CASE STUDY</b>                                                                         | <b>9 Periods</b> |
| Cascade control – Selective control – Feedforward control – Ratio control – Inferential control – Split-range – Smith Predictor Control - Control Schemes for Distillation Column, Heat Exchanger and Boiler drum level.                                                                                                                                                                                                         |                                                                                                                          |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                          |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                             |                                                                                                                          |                  |

**TEXT BOOKS:**

|   |                                                                                                                                                             |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | George Stephanopoulos, “ <b>Chemical Process Control – An Introduction to Theory and Practice</b> ”, 3 <sup>rd</sup> edition, Prentice Hall of India, 2015. |
| 2 | Coughanowr, D. R., & Leblanc, “ <b>Introductory concepts. Process Systems Analysis and Control</b> ”, 3 <sup>rd</sup> Ed, TMH ltd, 2017.                    |

**REFERENCES:**

|   |                                                                                                                                                                                             |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Bequette, “ <b>Process Control: Modeling, Design, and Simulation</b> ”, 2 <sup>nd</sup> edition, Prentice Hall of 2013                                                                      |
| 2 | Raghunathan Rengaswamy, Babji Srinivasan, Nirav Pravinbhai Bhatt “ <b>Process Control Fundamentals: Analysis, Design, Assessment, and Diagnosis</b> ”, 1 <sup>st</sup> Edition, wiley, 2020 |
| 3 | Aidan O'Dwyer, “ <b>Handbook of PI and PID Controller Tuning Rules</b> ”, 3 <sup>rd</sup> edition, Imperial College Press, 2009.                                                            |
| 4 | Michael King, “ <b>Process Control: A Practical Approach</b> ”, 3rd edition, Wiley, 2016.                                                                                                   |
| 5 | Seborg ,D.E., Mellichamp, D.P., Edgar, T.F., and Doyle,F.J., “ <b>Process Dynamics and Control</b> ”, John Wiley and Sons, 4 <sup>th</sup> Edition,2017                                     |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b>                                      |                                                                                                                             | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                                                             |                                |
| CO1                                                         | Develop the mathematical model using first principles approach for processes such as level, flow, temperature and pressure. | K3                             |
| CO2                                                         | Classify different controllers and analyze their responses                                                                  | K4                             |
| CO3                                                         | Apply various tuning techniques to attain the optimum gain in the composite controllers                                     | K4                             |
| CO4                                                         | Explain the types and characteristics of final control elements.                                                            | K2                             |
| CO5                                                         | Analyze various control schemes and recommend the suitable control strategy for industrial process.                         | K3                             |

## COURSE ARTICULATION MATRIX

| <b>a)CO/PO Mapping</b>                             |                                                                                                                                                                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                            | PO1                                                                                                                                                                                                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                | 3                                                                                                                                                                                                      | 3   | 1   | 2   | 2   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3    |
| CO2                                                | 3                                                                                                                                                                                                      | 3   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 3    |
| CO3                                                | 3                                                                                                                                                                                                      | 3   | 2   | 3   | 1   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3    |
| CO4                                                | 3                                                                                                                                                                                                      | 3   | 2   | 3   | -   | 1   | -   | -   | -   | -    | -    | -    | 1    | 3    | 3    |
| CO5                                                | 3                                                                                                                                                                                                      | 3   | 1   | 2   | 1   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3    |
| <b>22NPC621</b>                                    | 3                                                                                                                                                                                                      | 3   | 2   | 3   | 1   | 1   | -   | -   | -   | -    | -    | -    | 1    | 3    | 3    |
| <b>b)CO and Key Performance Indicators mapping</b> |                                                                                                                                                                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.2.1,3.2.3,4.1.3,4.1.4,4.2.2,4.3.1,4.3.2,4.3.3,5.1.1,5.2.1,5.2.2                    |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                | 1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.3,1.4.3.2,3.4.1.3,,4.2.1,4.3.1,4.3.2                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.3,3.2.1,3.2.2,,3.2.3,3.4.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.3,3.2.1,3.2.2,,3.2.3,3.4.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,6.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.3,3.2.1,3.2.3,4.1.2,4.1.3,4.1.4,4.2.2,4.3.1,4.3.2,4.3.3,5.1.1                    |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 30                | 30                   | 40             |                 |                   |                 | 100     |
| CAT2                                                         | 30                | 30                   | 40             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 20                   | 40             | 40              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 20                   | 40             | 40              |                   |                 | 100     |
| ESE                                                          | 10                | 30                   | 40             | 20              |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|          |                            |             |
|----------|----------------------------|-------------|
| 22NPC622 | INDUSTRIAL CONTROL SYSTEMS | SEMESTER VI |
|----------|----------------------------|-------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PC       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                 |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                           | To provide knowledge on various industrial automation controllers, such as PLCs, DCS and SCADA. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                   | <b>PLC FUNDAMENTALS</b>                                                                         | <b>9 Periods</b> |  |
| Overview of PLC systems – Parts of PLC –Input/output modules – Power supplies and Isolators – Fundamental PLC wiring diagram – Relays – Switches –Transducers – Sensors –Seal-in circuits – Relay logic - PLC Scanning - Overview of PLC programming languages                                                                                                                                    |                                                                                                 |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                  | <b>PLC PROGRAMMING</b>                                                                          | <b>9 Periods</b> |  |
| Fundamentals of logic – Converting Relay Schematics into PLC ladder diagrams- Construction of PLC ladder diagram – Timers – Counters - Math instructions – Data Manipulation instructions – Sequencer and Shift register instructions - Analog PLC operation – PID Control - PLC Installation and Troubleshooting– Application of PLC – Bottle filling System, Elevator control, Reactor control. |                                                                                                 |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                 | <b>FIELD BUS</b>                                                                                | <b>9 Periods</b> |  |
| Overview of OSI model - Different types of Communication Buses - MODBUS – HART Protocol - Profibus – Profinet - Foundation Fieldbus: H1 and HSE - Industrial Ethernet.                                                                                                                                                                                                                            |                                                                                                 |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                  | <b>SCADA AND HMI</b>                                                                            | <b>9 Periods</b> |  |
| Introduction – SCADA systems – Elements and Functionality of SCADA– Remote terminal units – Communication architectures – Open SCADA protocol DNP3 and IEC 60870 - HMI - Hardware components - Software configuration.                                                                                                                                                                            |                                                                                                 |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                   | <b>DISTRIBUTED CONTROL SYSTEMS</b>                                                              | <b>9 Periods</b> |  |
| DCS – Various Architectures – Comparison – Local control unit – Process interfacing issues – Communication facilities – Low- and High-level engineering and operator interfaces - Case studies in DCS: Yokogawa, Siemens and Honeywell.                                                                                                                                                           |                                                                                                 |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                |                                                                                                 |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                              |                                                                                                 |                  |  |

**TEXT BOOKS:**

|   |                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------|
| 1 | <i>F.D.Petruzella, “Programmable Logic Controllers”, Tata McGraw Hill, 5<sup>th</sup> Edition, 2017.</i> |
| 2 | <i>M.P.Lukas, “Distributed Control Systems”, Van Nostrand Reinhold Co, 1<sup>st</sup> Edition, 1986.</i> |

**REFERENCES:**

|   |                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>John.W. Webb Ronald A Reis, “Programmable Logic Controllers - Principles and Applications”, Pearson Education, 5<sup>th</sup> Edition, 2003.</i>   |
| 2 | <i>Bolton. W, “Programmable Logic Controllers”, Elsevier Newnes, 6<sup>th</sup> Edition, 2016.</i>                                                    |
| 3 | <i>Bela.G.Liptak, “Process Software and Digital Networks – Volume 3”, CRC Press, 4<sup>th</sup> Edition, 2012.</i>                                    |
| 4 | <i>G.Clarke, D.Reynders and E.Wright, “Practical Modern SCADA Protocols:DNP3, 60870.5 and Related Systems”, 1<sup>st</sup> Newnes, Edition, 2004.</i> |
| 5 | <i>IDC Technologies, “Practical Distributed Control Systems (DCS) for Engineers and Technicians”2012.</i>                                             |

| COURSE OUTCOMES                                             |                                                                 | Bloom’s Taxonomy Mapped |
|-------------------------------------------------------------|-----------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                 |                         |
| CO1                                                         | Elaborate the basic modules and functions of PLC                | K2                      |
| CO2                                                         | Construct PLC ladder logic programs for real-time applications. | K4                      |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                                                                        |    |
|-----|--------------------------------------------------------------------------------------------------------|----|
| CO3 | Explain the function of latest communication technologies like HART and fieldbus in automation systems | K2 |
| CO4 | Elucidate the supervisory control using elements and functionalities of SCADA.                         | K2 |
| CO5 | Enunciate security design approaches, engineering and operator interfaces for different DCS.           | K2 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                         |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                       | 2   | 1   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    | 2    | 3    |
| CO2                                                 | 3                                                                                                       | 2   | 1   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    | 2    | 3    |
| CO3                                                 | 3                                                                                                       | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 2    | 3    |
| CO4                                                 | 3                                                                                                       | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 2    | 3    |
| CO5                                                 | 3                                                                                                       | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 2    | 3    |
| <b>22NPC622</b>                                     | 3                                                                                                       | 2   | 1   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    | 2    | 3    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                         |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 40                   | 20             | 20             |                   |                 | 100     |
| CAT2                                                         | 20                | 40                   | 20             | 20             |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 40                   | 40             | 20             |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 40                   | 40             | 20             |                   |                 | 100     |
| ESE                                                          | 20                | 40                   | 20             | 20             |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                              |                    |
|-----------------|------------------------------|--------------------|
| <b>22NPC623</b> | <b>BASICS OF VLSI DESIGN</b> | <b>SEMESTER VI</b> |
|-----------------|------------------------------|--------------------|

| PREREQUISITES                                                                                                             | CATEGORY | L | T | P | C |
|---------------------------------------------------------------------------------------------------------------------------|----------|---|---|---|---|
| 1. 22NPC302 ANALOG ELECTRONICS<br>2. 22NPC407 ELECTRONICS FOR ANALOG SIGNAL PROCESSING<br>3. 22NPC408 DIGITAL ELECTRONICS | PC       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                            |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                        | To familiarize the characteristics, analysis and design of CMOS logic circuits and networks for the realization of VLSI system components. |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                | <b>INTRODUCTION TO VLSI DESIGN</b>                                                                                                         | <b>9 Periods</b> |
| VLSI: Circuits – Basic features and Design issues – MOS Transistors – CMOS logic – Basic logic gates – Complex logic gates – Transmission gates – CMOS Fabrication process – Layout design rules – Gate layout – Stick diagrams – Physical structure of MOSFET – CMOS layers– Layout of Basic structures – Cell concepts – FET sizing – physical design and design hierarchies |                                                                                                                                            |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                               | <b>CHARACTERISTICS AND ANALYSIS OF CMOS CIRCUITS</b>                                                                                       | <b>9 Periods</b> |
| MOSFET: nFET Voltage – current equations – FET RC Model – pFET characteristics – CMOS Inverter: DC characteristics – Inverter Switching Characteristics – Power dissipation – Transient response – Analysis of Complex Logic gates                                                                                                                                             |                                                                                                                                            |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                              | <b>DESIGN OF HIGH-SPEED CMOS NETWORKS</b>                                                                                                  | <b>9 Periods</b> |
| Gate delays – Driving large capacitive loads – logical effort – Advanced logic circuits: Mirror circuits – Psuedo-nMOS – Tristate circuits – Clocked and Dynamic CMOS – Dual rail logic networks                                                                                                                                                                               |                                                                                                                                            |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                               | <b>DESIGN OF VLSI SYSTEMS</b>                                                                                                              | <b>9 Periods</b> |
| Basic concepts – Structural gate level modeling – Switch level modeling – Behavioral and RTL modeling – System components – Adders - Comparators - Priority encoders- Binary decoders –Multiplexers – Latches – Flip flops – Registers – Static and Dynamic RAM – ROM and Logic arrays                                                                                         |                                                                                                                                            |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                | <b>CLOCKING, RELIABILITY AND TESTING OF VLSI SYSTEMS</b>                                                                                   | <b>9 Periods</b> |
| Clocked flip flops – CMOS clocking styles – Pipelined systems – Clock generation and distribution – Overview of VLSI testing – Need for testing – Fault models – Manufacturing test principles – chip level and system level test principles - Build-In-Self-Test.                                                                                                             |                                                                                                                                            |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                            |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                           |                                                                                                                                            |                  |

**TEXT BOOKS:**

|   |                                                                                                                            |
|---|----------------------------------------------------------------------------------------------------------------------------|
| 1 | John P. Uyemura, “ <i>Introduction to VLSI circuits and Systems</i> ”, John Wiley and Sons, 4 <sup>th</sup> edition, 2001. |
| 2 | N. Westeet., “ <i>CMOS VLSI Design</i> ”, Pearson Education, 3 <sup>rd</sup> Edition, 2013.                                |

**REFERENCES:**

|   |                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------|
| 1 | R. Jacob Baker, “ <i>CMOS: Circuit Design, Layout, and Simulation</i> ”, Wiley-IEEE, 4 <sup>th</sup> Edition, 2019.     |
| 2 | Ming Bo-Lin, “ <i>Introduction to VLSI systems</i> ”, CRC Press, 1 <sup>st</sup> Edition, 2012.                         |
| 3 | Neil h. E. Weste and David Money Harris, “ <i>CMOS VLSI DESIGN</i> ”, Pearson Education, 4 <sup>th</sup> Edition, 2015. |
| 4 | David A Pucknell, “ <i>Basic VLSI design</i> ”, Prentice Hall, 3 <sup>rd</sup> Edition, 2007.                           |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                                            | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Construct logic circuits with MOSFETs                                                                      | K4                                     |
| CO2                                                                                   | Describe the characteristics of CMOS circuits and analyse them to determine different parameters.          | K3                                     |
| CO3                                                                                   | Design high speed CMOS logic circuits                                                                      | K4                                     |
| CO4                                                                                   | Design and model various VLSI system components and arithmetic circuits                                    | K4                                     |
| CO5                                                                                   | Explain the clocking styles to design VLSI systems and test VLSI systems using various testing principles. | K3                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                            | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                              | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO2                                                 | 3                                                                                                              | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO3                                                 | 3                                                                                                              | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO4                                                 | 3                                                                                                              | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO5                                                 | 3                                                                                                              | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| <b>22NPC623</b>                                     | 3                                                                                                              | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.1, 3.1.1, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.4.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.1, 3.1.1, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.4.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.1, 3.1.1, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.4.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.1, 3.1.1, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.4.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.1, 3.1.1, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.4.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 30                   | 40             | 20              |                   |                 | 100     |
| CAT2                                                         | 10                | 30                   | 40             | 20              |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 20                   | 40             | 40              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 20                   | 40             | 40              |                   |                 | 100     |
| ESE                                                          | 10                | 30                   | 40             | 20              |                   |                 | 100     |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                   |                    |
|-----------------|-----------------------------------|--------------------|
| <b>22NPC624</b> | <b>PROCESS CONTROL LABORATORY</b> | <b>SEMESTER VI</b> |
|-----------------|-----------------------------------|--------------------|

| <b>PREREQUISITES</b>                                                        | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|-----------------------------------------------------------------------------|-----------------|----------|----------|----------|----------|
| 1. 22NPC409 INDUSTRIAL INSTRUMENTATION<br>2. 22NPC513 CONTROL SYSTEM DESIGN | PC              | 0        | 0        | 3        | 1.5      |

|                         |                                                                                                                                                          |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | To provide hands-on training with experimentally modeling of process, characteristics of control valves, controller tuning and advanced process control. |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>LIST OF EXPERIMENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 1. Characteristics of control valves.<br>2. Characteristics of process with and without transportation delay<br>3. Response of inverse process.<br>4. Experimental modelling of Interacting and Non-Interacting process<br>5. Experimental modelling of a Flow, Level, Pressure and Temperature process.<br>6. Tuning of controllers using Cohen-Coon and Ziegler Nichols method<br>7. Comparison of controller responses for a Level process.<br>8. Comparison of controller responses for a Flow process.<br>9. Comparison of controller responses for a Pressure process.<br>10. Comparison of controller responses for a Temperature process.<br>11. Implementation of multi-loop control schemes like feed-forward controller / Cascade controller/ Ratio control for Linear and Non Linear processes.<br>12. Approximation of higher order process into first order with dead time process. |

|                                                                                                      |
|------------------------------------------------------------------------------------------------------|
| <b>Contact Periods: 45 Periods</b>                                                                   |
| <b>Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods</b> |

| <b>COURSE OUTCOMES</b>                                      |                                                                                                     | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to |                                                                                                     |                                |
| CO1                                                         | Experimentally measure industrial process parameters such as Flow, Pressure, Viscosity and Humidity | K3                             |
| CO2                                                         | Obtain the characteristics of electro-pneumatic Converter and control valves.                       | K3                             |
| CO3                                                         | Obtain the experimental modelling for Pressure, Temperature, Level and Flow process.                | K4                             |
| CO4                                                         | Tune the controller parameters for Pressure, Temperature, Level and Flow process                    | K4                             |
| CO5                                                         | Analyze the performance of controller responses for various process                                 | K4                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b> |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                     | 3   | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 2    | -    | 3    | 3    |
| CO2                     | 3   | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 2    | -    | 3    | 3    |
| CO3                     | 3   | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 2    | -    | 3    | 3    |
| CO4                     | 3   | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 2    | -    | 3    | 3    |
| CO5                     | 3   | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 2    | -    | 3    | 3    |
| <b>22NPC624</b>         | 3   | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 2    | -    | 3    | 3    |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING****b) CO and Key Performance Indicators mapping**

|     |                                                                                                                                                                                          |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 4.1.2, 5.1.1, 8.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2, 12.2.1, 12.2.2 |
| CO2 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 4.1.2, 5.1.1, 8.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2, 12.2.1, 12.2.2 |
| CO3 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 4.1.2, 5.1.1, 8.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2, 12.2.1, 12.2.2 |
| CO4 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 4.1.2, 5.1.1, 8.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2, 12.2.1, 12.2.2 |
| CO5 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 4.1.2, 5.1.1, 8.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2, 12.2.1, 12.2.2 |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                              |                    |
|-----------------|----------------------------------------------|--------------------|
| <b>22NPC625</b> | <b>INDUSTRIAL CONTROL SYSTEMS LABORATORY</b> | <b>SEMESTER VI</b> |
|-----------------|----------------------------------------------|--------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|----------------------|-----------------|----------|----------|----------|------------|
| <b>NIL</b>           | <b>PC</b>       | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |

|                         |                                                                                                                                                                                          |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | To impart knowledge on configuring, programming, interfacing of field devices with various industrial automation controllers, such as PLCs and DCSs, and monitoring using SCADA and HMI. |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**LIST OF EXPERIMENTS**

1. Simple exercises using the instruction set of an industrial type PLC.
2. (i) Study of PLC field device interface modules (AI, AO, DI, DO Modules)  
(ii) Interfacing Analog/Digital input/output devices with industrial type PLC
3. Control of Bottle filling process using PLC
4. Speed Control of DC motor/Servo motor/induction motor using PLC
5. Traffic light control using PLC
6. Lift control using PLC
7. Control of Batch Process Reactor system using PLC
8. Control of a typical Process using PLC
9. (i) Study of DCS field device interface modules (AI, AO, DI, DO Modules)  
(ii) Interfacing Analog/Digital input/output devices with an industrial type DCS
10. Control of flow and level process using DCS.
11. SCADA/HMI development for the Industrial Process Stations (Flow/ Level/ Pressure/ Temperature)
12. IoT based Monitoring of Industrial Process.
13. Development of P&ID design for Industrial Process.

**Contact Periods: 45 Periods**

**Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods**

| <b>COURSE OUTCOMES</b>                                      |                                                                                        | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to |                                                                                        |                                |
| CO1                                                         | Develop PLC programming for industrial applications                                    | K4                             |
| CO2                                                         | Configure PLC and DCS                                                                  | K4                             |
| CO3                                                         | Develop feedback control for a plant using PLC/DCS and monitor the process parameters. | K4                             |
| CO4                                                         | Develop SCADA/HMI for industrial applications                                          | K4                             |
| CO5                                                         | Configuring IoT module for monitoring of industrial processes.                         | K4                             |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                                                                                      | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                                                                                                        | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 1    | 1    | 2    | 3    |
| CO2                                                 | 3                                                                                                                                                                                        | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 1    | 1    | 2    | 3    |
| CO3                                                 | 3                                                                                                                                                                                        | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 1    | 1    | 2    | 3    |
| CO4                                                 | 3                                                                                                                                                                                        | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 1    | 1    | 2    | 3    |
| CO5                                                 | 3                                                                                                                                                                                        | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 1    | 1    | 2    | 3    |
| <b>22NPC625</b>                                     | 3                                                                                                                                                                                        | 2   | 2   | 1   | 1   | -   | -   | 1   | 2   | 1    | -    | 1    | 1    | 2    | 3    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 4.1.2, 5.1.1, 8.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2, 12.2.1, 12.2.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 4.1.2, 5.1.1, 8.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2, 12.2.1, 12.2.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 4.1.2, 5.1.1, 8.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2, 12.2.1, 12.2.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 4.1.2, 5.1.1, 8.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2, 12.2.1, 12.2.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 4.1.1, 4.1.2, 5.1.1, 8.2.1, 9.1.1, 9.2.2, 9.2.3, 9.2.4, 10.1.1, 10.1.2, 12.2.1, 12.2.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |



|                 |                                                            |                    |
|-----------------|------------------------------------------------------------|--------------------|
| <b>22NES609</b> | <b>DESIGN THINKING FOR INSTRUMENTATION<br/>ENGINEERING</b> | <b>SEMESTER VI</b> |
|-----------------|------------------------------------------------------------|--------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b>   |
|----------------------|-----------------|----------|----------|----------|------------|
| <b>NIL</b>           | <b>ES</b>       | <b>0</b> | <b>0</b> | <b>3</b> | <b>1.5</b> |

|                                                                                                                                                                                                                                                                                                                                                          |                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                  | Teach students how to use design tools and processes and to analyse problems with design thinking. |
| <b>DESIGN THINKING PROCESS AND PRACTICE</b>                                                                                                                                                                                                                                                                                                              |                                                                                                    |
| Design thinking: Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts and Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test.                                                                                                              |                                                                                                    |
| Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving.                                                                                                                                                                                                                                                |                                                                                                    |
| Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design.                                                                                                                                                                      |                                                                                                    |
| Students should do a field visit and identify a real-world problem. They are expected to identify their target customers and objective/use case. They are expected to provide possible solutions to the identified problem. They can present a proof-of-concept/ Minimum Usable Product/Prototype. Student should submit a report and pitch their ideas. |                                                                                                    |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                       |                                                                                                    |
| <b>Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 45 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                     |                                                                                                    |

| <b>COURSE OUTCOMES</b>                                    |                                                                                                  | <b>Bloom's Taxonomy Mapped</b> |
|-----------------------------------------------------------|--------------------------------------------------------------------------------------------------|--------------------------------|
| On completion of the course, the students will be able to |                                                                                                  |                                |
| CO1                                                       | Apply the Electronics and Instrumentation Engineering knowledge to solve the real world problems | K3                             |
| CO2                                                       | Prepare model/layout drawings using suitable software tools.                                     | K4                             |
| CO3                                                       | Evaluate the suitable approaches to obtain a required final result.                              | K4                             |
| CO4                                                       | Predict the outcome of the suggested approach in the form of a product.                          | K4                             |
| CO5                                                       | Acquire skills to communicate efficiently and work as a team in multidisciplinary projects       | K2                             |

### COURSE ARTICULATION MATRIX

#### a) CO/PO Mapping

| COs/POs         | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| CO1             | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 2   | 1    | 2    | 3    | 3    | 3    | 3    |
| CO2             | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 2   | 1    | 2    | 3    | 3    | 3    | 3    |
| CO3             | 2   | 2   | 2   | 2   | 1   | 2   | 2   | 3   | 3   | 3    | 3    | 3    | 3    | 3    | 3    |
| CO4             | 2   | 2   | 2   | 2   | 1   | 2   | 2   | 3   | 3   | 3    | 3    | 3    | 3    | 3    | 3    |
| CO5             | 2   | 2   | 2   | 2   | 1   | 2   | 2   | 3   | 3   | 3    | 3    | 3    | 3    | 3    | 3    |
| <b>22NES609</b> | 3   | 3   | 3   | 3   | 2   | 3   | 3   | 3   | 3   | 3    | 3    | 3    | 3    | 3    | 3    |

#### b) CO and Key Performance Indicators mapping

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.3, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |
| CO2 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.3, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |
| CO3 | 1.2.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.1, 4.1.1, 4.1.2, 4.3.3, 5.1.1, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2                                                                                                                                     |
| CO4 | 1.2.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.1, 4.1.1, 4.1.2, 4.3.3, 5.1.1, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2                                                                                                                                     |
| CO5 | 1.2.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.1, 4.1.1, 4.1.2, 4.3.3, 5.1.1, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2                                                                                                                                     |



|                 |                                       |                     |
|-----------------|---------------------------------------|---------------------|
| <b>22NES710</b> | <b>FUNDAMENTALS OF SOFT COMPUTING</b> | <b>SEMESTER VII</b> |
|-----------------|---------------------------------------|---------------------|

| <b>PREREQUISITES</b>                  | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---------------------------------------|-----------------|----------|----------|----------|----------|
| <b>22NPC408 - DIGITAL ELECTRONICS</b> | <b>ES</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                   |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <ul style="list-style-type: none"><li>To familiarize various architectures of neural networks, concepts of fuzzy control and genetic algorithms and its hybrid schemes.</li></ul> |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>INTRODUCTION TO NEURAL NETWORKS</b>                                                                                                                                            | <b>9 Periods</b> |  |
| Motivation for the development of neural networks - artificial neural networks and biological neural networks - application areas. Typical architectures - setting weights - common activation functions, biases and thresholds, linear separability, data representation. Architecture, algorithm, application: McCulloch-pitts neuron, Simple neural networks for pattern classification, Hebb net, Perceptron- perceptron learning rule convergence theorem - delta rule.                            |                                                                                                                                                                                   |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>NEURAL NETWORK ALGORITHMS</b>                                                                                                                                                  | <b>9 Periods</b> |  |
| Back propagation Network (BPN) - algorithm (BPA) – ADALINE and MADALINE Networks - Recurrent Neural Network (RNN) –Adaptive Resonance Theory (ART) based network – Radial Basis Function (RBF) network – online learning algorithms, BP through time – RTRL algorithms –Reinforcement learning, Kohonen’s Self Organizing Map (K-SOM)- Counter propagation Networks – Neural networks for control: Schemes of neuro control – Inverse dynamics. Case study: Neuro controller for a temperature process. |                                                                                                                                                                                   |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>FUZZY SET THEORY</b>                                                                                                                                                           | <b>9 Periods</b> |  |
| Fuzzy set theory – Fuzzy sets – Operation on fuzzy sets – Scalar cardinality, fuzzy cardinality, union and intersection - complement:Yager and Sugeno - equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation – Fuzzy Membership functions: Triangular, Trapezoidal - scale factors- Fuzzy logic Controller : Functional diagram.                                                                                                                             |                                                                                                                                                                                   |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>FUZZY CONTROLLER STRUCTURE</b>                                                                                                                                                 | <b>9 Periods</b> |  |
| Fuzzy Logic controller – Fuzzification: Membership value assignments using intuition - Knowledge base – Decision making logic: Choice of variable - rule base,derivation of rules, database - Defuzzification: Max-Membership principle, centroid method, weighted average method - Modeling of nonlinear systems using fuzzy models : Mamdani , Sugeno and Takagi-Sugeno-Kang (TSK) model– Case study : Fuzzy logic Controller design for a temperature process.                                       |                                                                                                                                                                                   |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>HYBRID CONTROL SCHEMES</b>                                                                                                                                                     | <b>9 Periods</b> |  |
| Neuro fuzzy systems –Adaptive Neuro Fuzzy Inference System (ANFIS) – Genetic Algorithm (GA) – flow chart of GA – Genetic representations : encoding, Initialization and selection, Crossover, Mutation, Generational Cycle - Simple Hand Calculation of GA – Optimization of membership function and rule base using GA.                                                                                                                                                                                |                                                                                                                                                                                   |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                   |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                   |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                                |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Laurene. V, Fausett, “ <i>Fundamentals of Neural Networks, Architecture, Algorithms, and Applications</i> ”, 1 <sup>st</sup> edition, Pearson Education, 2008. |
| 2 | Timothy. J, Ross, “ <i>Fuzzy Logic with Engineering Applications</i> ”, 3 <sup>rd</sup> Edition, Wiley, 2010.                                                  |

**REFERENCES:**

|   |                                                                                                                                                   |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Miller W.T, Sutton . R.S and Webrose . P.J, “ <i>Neural Networks for Control</i> ”, MIT Press, 1 <sup>st</sup> edition, 1996.                     |
| 2 | Zimmermann. H.J, “ <i>Fuzzy set theory-and its Applications</i> ”, Springer International edition, 3 <sup>rd</sup> Edition, 2011.                 |
| 3 | Driankov D, Hellendoorn H. and Reinfrank M., “ <i>An Introduction to Fuzzy Control</i> ”, Narosa Publishing House, 3 <sup>rd</sup> Edition, 1996. |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|    |                                                                                                                                                                                              |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4  | David Goldberg. V “ <b>Genetic Algorithms in Search, Optimization, and Machine Learning</b> ” Pearson Education, 1 <sup>st</sup> edition, 2009.                                              |
| 5. | S. N. Sivanandam , S. N. Deepa, “ <b>Principles of Soft Computing</b> ”, Wiley, 3 <sup>rd</sup> edition , 2018.                                                                              |
| 6. | S. Rajasekaran , G. A. Vijayalakshmi Pai, “ <b>Neural Networks, Fuzzy Logic, and Genetic Algorithms : Synthesis and Applications</b> ”, Prentice Hall India, 3 <sup>rd</sup> edition , 2013. |

| COURSE OUTCOMES                                             |                                                                                      | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                                      |                         |
| CO1                                                         | Explain the various architectures of neural networks                                 | K2                      |
| CO2                                                         | Illustrate advanced networks for control applications                                | K3                      |
| CO3                                                         | Describe the concepts of fuzzy sets and logic.                                       | K2                      |
| CO4                                                         | Apply the fuzzy concepts to simple problems of digital applications.                 | K3                      |
| CO5                                                         | Explore the Terminologies and operations of GA and configurations of Hybrid schemes. | K2                      |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping                             |                                                                                                                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                      | PO1                                                                                                                  | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                          | 3                                                                                                                    | 2        | 2        | 2        | -        | -        | -        | -        | -        | -        | -        | 2        | 1        | 2        | 1        |
| CO2                                          | 3                                                                                                                    | 2        | 2        | 2        | -        | -        | -        | -        | -        | -        | -        | 2        | 1        | 2        | 1        |
| CO3                                          | 3                                                                                                                    | 2        | 2        | 2        | -        | -        | -        | -        | -        | -        | -        | 2        | 1        | 2        | 1        |
| CO4                                          | 3                                                                                                                    | 2        | 2        | 2        | -        | -        | -        | -        | -        | -        | -        | 2        | 1        | 2        | 1        |
| CO5                                          | 3                                                                                                                    | 2        | 2        | 2        | -        | -        | -        | -        | -        | -        | -        | 2        | 1        | 2        | 1        |
| <b>22NES710</b>                              | <b>3</b>                                                                                                             | <b>2</b> | <b>2</b> | <b>2</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>2</b> | <b>1</b> | <b>2</b> | <b>1</b> |
| b) CO and Key Performance Indicators mapping |                                                                                                                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                          | 1.1.1,1.1.2,1.3.1,2.1.1,2.2.1,2.2.3,2.3.1,2.4.1,2.4.2,2.4.3.1.6,3.2.1,4.3.1.6,3.3.1,4.1.2,4.3.2,12.1.2,12.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                          | 1.1.1,1.1.2,1.3.1,2.1.1,2.2.1,2.2.3,2.3.1,2.4.1,2.4.2,2.4.3.1.6,3.2.1,4.3.1.6,3.3.1,4.1.2,4.3.2,12.1.2,12.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                          | 1.1.1,1.1.2,1.3.1,2.1.1,2.2.1,2.2.3,2.3.1,2.4.1,2.4.2,2.4.3.1.6,3.2.1,4.3.1.6,3.3.1,4.1.2,4.3.2,12.1.2,12.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                          | 1.1.1,1.1.2,1.3.1,2.1.1,2.2.1,2.2.3,2.3.1,2.4.1,2.4.2,2.4.3.1.6,3.2.1,4.3.1.6,3.3.1,4.1.2,4.3.2,12.1.2,12.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                          | 1.1.1,1.1.2,1.3.1,2.1.1,2.2.1,2.2.3,2.3.1,2.4.1,2.4.2,2.4.3.1.6,3.2.1,4.3.1.6,3.3.1,4.1.2,4.3.2,12.1.2,12.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

| ASSESSMENT PATTERN - THEORY                                  |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 30                | 40                   | 30             |                 |                   |                 | 100     |
| CAT2                                                         | 30                | 40                   | 30             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 50             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 50             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 50                   | 30             |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                              |                     |
|-----------------|----------------------------------------------|---------------------|
| <b>22NPC726</b> | <b>POWER ELECTRONIC DEVICES AND CIRCUITS</b> | <b>SEMESTER VII</b> |
|-----------------|----------------------------------------------|---------------------|

| PREREQUISITES                       | CATEGORY  | L        | T        | P        | C        |
|-------------------------------------|-----------|----------|----------|----------|----------|
| <b>22NPC302- ANALOG ELECTRONICS</b> | <b>PC</b> | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                       |                  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"><li>To impart knowledge on various power electronic devices and circuits.</li></ul> |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                    | <b>POWER SEMICONDUCTOR DEVICES</b>                                                                                    | <b>9 Periods</b> |  |
| Basic structure and switching characteristics of power diode- Power transistor- SCR- TRIAC- GTO- MOSFET and IGBT- Ratings of SCR- Series parallel operation of SCR- di/dt and dv/dt protection Introduction of ICT, SIT, SITH and MCT- Triggering circuits.                                                                                                        |                                                                                                                       |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                   | <b>CONTROLLED RECTIFIERS</b>                                                                                          | <b>9 Periods</b> |  |
| Operation of single -phase half wave rectifier with R- RL- and RLE load – Single phase full wave rectifier with R- RL and RLE load (Fully controlled and half controlled) - Three phase half wave rectifier and full wave rectifier with R and RL loads - Effect of source inductance in single-phase full wave rectifier - Single phase dual converter operation. |                                                                                                                       |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                  | <b>DC CHOPPERS</b>                                                                                                    | <b>9 Periods</b> |  |
| Types of forced commutation - Classification and operation of different types of choppers (A- B- C- D- E) - Control strategies - Operation of voltage-Current and load commutated choppers - Multiphase chopper operation - SMPS.                                                                                                                                  |                                                                                                                       |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                   | <b>INVERTERS</b>                                                                                                      | <b>9 Periods</b> |  |
| Types of inverters - Operation of single phase, three phase (120° and 180°) modes for R- load operation of CSI with ideal switches – Single phase ASCSI, basic series Inverter - Modified series and Improved series inverter - Single phase parallel inverter - Single phase basic McMurray inverter.                                                             |                                                                                                                       |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                    | <b>AC VOLTAGE CONTROLLERS</b>                                                                                         | <b>9 Periods</b> |  |
| Types of control (Phase and Integrated cycle control) - Operation of single-phase voltage regulator with R and RL loads- Three-phase AC voltage controller with R load - Single-phase step up and step down cyclo converters - Three phase cyclo converter with R and RL loads.                                                                                    |                                                                                                                       |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                 |                                                                                                                       |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                               |                                                                                                                       |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                              |
|---|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Muhammad H. Rashid- <i>“Power Electronics - Circuits- Devices and Applications”</i> - Prentice Hall of India, 3 <sup>rd</sup> Edition, 2005. |
| 2 | Ned Mohan, <i>“Power Electronics-Converter Applications and Design”</i> , Wiley, 3 <sup>rd</sup> Edition, Reprint 2011.                      |

**REFERENCES:**

|   |                                                                                                                                    |
|---|------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Bose, B.K., <i>“Modern Power Electronics and AC Drives”</i> , Pearson Education, 2002.                                             |
| 2 | Dr. P.S.Bhimbra., <i>“Power Electronics”</i> Khanna Publishers, 2018.                                                              |
| 3 | Singh. M.D and Khanchandani. K.B <i>“Power Electronics”</i> Tata McGraw Hill Publishing Co. Ltd, 3 <sup>rd</sup> Reprint 2008.     |
| 4 | Vedam Subramaniam- <i>“Power Electronics”</i> - New Age International (P) Publishers Ltd. – 2 <sup>nd</sup> Edition, Reprint 2011. |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                                             | <b>Bloom's Taxonomy Mapped</b> |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------|--------------------------------|
| CO1                                                                                   | Explain the basic structure, switching characteristics, and ratings of various power semiconductor devices. | K2                             |
| CO2                                                                                   | Describe the operation of single-phase and three-phase rectifiers with different loads.                     | K2                             |
| CO3                                                                                   | Classify different types of choppers and comprehend their control strategies.                               | K2                             |
| CO4                                                                                   | Compare various types of inverters and their modes of operation for different loads.                        | K2                             |
| CO5                                                                                   | Elaborate principles and operation of voltage regulation and cyclo converters.                              | K2                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                  |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                              | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | -    |
| CO2                                                 | 3                                                                                                | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | -    |
| CO3                                                 | 3                                                                                                | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | -    |
| CO4                                                 | 3                                                                                                | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | -    |
| CO5                                                 | 3                                                                                                | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | -    |
| <b>22NPC726</b>                                     | 3                                                                                                | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 1    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                  |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 80                   |                |                |                   |                 | 100     |
| CAT2                                                         | 20                | 80                   |                |                |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 80                   |                |                |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 80                   |                |                |                   |                 | 100     |
| ESE                                                          | 20                | 80                   |                |                |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                                                      |                               |              |   |   |   |   |
|------------------------------------------------------|-------------------------------|--------------|---|---|---|---|
| 22NPC727                                             | INSTRUMENTATION SYSTEM DESIGN | SEMESTER VII |   |   |   |   |
| PREREQUISITES:                                       |                               | CATEGORY     | L | T | P | C |
| 1. 22NPC407 ELECTRONICS FOR ANALOG SIGNAL PROCESSING |                               | PC           | 2 | 0 | 4 | 4 |
| 2. 22NPC409 INDUSTRIAL INSTRUMENTATION               |                               |              |   |   |   |   |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                       |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | To impart knowledge on the design of instrumentation systems for various industrial process variables and components. |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>OVERVIEW OF OP-AMP CIRCUITS</b>                                                                                    | <b>6 Periods</b> |
| Analog and Digital signal conditioning – Signal level and bias changes – Linearization – Conversion - Filtering - Concept of loading and impedance matching – Op-Amp circuits for instrumentation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                       |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>DESIGN OF FLOW AND TEMPERATURE MEASURING INSTRUMENTS</b>                                                           | <b>6 Periods</b> |
| Orifice sizing for a given flow condition - Design of rotameter - zero and span adjustment in D/P transmitters - Temperature transmitters: Design of signal conditioning circuit for RTD - Design of cold junction compensation circuit for thermocouple.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                       |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>DESIGN OF PRESSURE &amp; LEVEL MEASURING INSTRUMENTS AND P&amp;I DIAGRAM</b>                                       | <b>6 Periods</b> |
| Bourdon gauges - Factors affecting sensitivity - Design of Bourdon tube - Design of the Air purge system for level measurement - Configuring D/P transmitters for level measurement. Case study: Piping and Instrumentation Diagram.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                       |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>DESIGN OF FINAL CONTROL ELEMENT</b>                                                                                | <b>6 Periods</b> |
| Control valves: Sizing of control valves - Selection of body materials and characteristics of control valves for typical applications - Design of actuators and positioners. Types of pumps - Pipework calculation - selection of pumps - Complete air supply system for pneumatic control equipment.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                       |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>DESIGN OF PID CONTROLLER AND LOGIC CIRCUITS</b>                                                                    | <b>6 Periods</b> |
| Electronic P+I+D controllers : Design - adjustment of setpoint, bias and controller settings - Design of $\mu$ p/ $\mu$ c based system for data acquisition and P+I+D controller. Design of logic circuits for alarm, interlocks and annunciator systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                       |                  |
| <b>LIST OF EXPERIMENTS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                       |                  |
| <div>1. Design of Instrumentation amplifiers</div> <div>2. Design of frequency selective Filters</div> <div>3. Design of V/I and I/V converters</div> <div>4. Design and implementation of cold junction compensation circuits for thermocouple.</div> <div>5. Design of signal conditioning circuit for RTD.</div> <div>6. Design of orifice plate sizing.</div> <div>7. Design of rotameter.</div> <div>8. Control valve sizing.</div> <div>9. Design and implementation of ON/OFF controller for a temperature process.</div> <div>10. Design and implementation of electronic PID controllers.</div> <div>11. Design of auto/manual switch for PID controllers.</div> <div>12. Design of <math>\mu</math>p/<math>\mu</math>c based P+I+D controller.</div> <div>13. Design of alarm and annunciator circuits.</div> <div>14. Realization of first order and second order systems with dead time using electronic circuits.</div> <div>15. Piping and Instrumentation Diagram – case study</div> |                                                                                                                       |                  |
| <b>Contact Periods: 90 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                       |                  |
| <b>Lecture: 30 Periods    Tutorial: 0 Periods    Practical: 60 Periods    Total: 90 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                       |                  |

**TEXT BOOKS:**

|   |                                                                                                                                |
|---|--------------------------------------------------------------------------------------------------------------------------------|
| 1 | C.D. Johnson, “ <b>Process Control Instrumentation Technology</b> ”, Prentice Hall of India, 8 <sup>th</sup> Edition, 2015.    |
| 2 | N.A.Anderson, “ <b>Instrumentation for Process Measurement and Control</b> ”, Berlin: Springer, 3 <sup>rd</sup> Edition, 2000. |

## REFERENCES:

|   |                                                                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | D.M.Considine, " <b>Process Instruments and Controls Handbook</b> ", McGraw-Hill., 5 <sup>th</sup> Edition, 1997                                                                           |
| 2 | R.H.Warring, " <b>Pumping Manual</b> ", Gulf Publishing Co., 1984.                                                                                                                         |
| 3 | J.P.Bentley, " <b>Principles of Measurement Systems</b> ", Pearson Education Asia Pvt. Ltd., New 3 <sup>rd</sup> Edition, 2000.                                                            |
| 4 | Michael D.Whitt, " <b>Successful instrumentation and control systems design</b> ", Instrumentation, System and Automation Society, United States of America, 1 <sup>st</sup> Edition, 2004 |

| COURSE OUTCOMES                                             |                                                                                                                        | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                                                                        |                         |
| CO1                                                         | Design and implement analog and digital signal conditioning circuits, filters, converters for instrumentation systems. | K4                      |
| CO2                                                         | Develop signal conditioning circuits for flow and temperature measuring instruments                                    | K4                      |
| CO3                                                         | Design of pressure and level measuring instruments                                                                     | K4                      |
| CO4                                                         | Design of the final control elements.                                                                                  | K4                      |
| CO5                                                         | Design and implementation of PID controller and logic circuits.                                                        | K4                      |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs          | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1              | 3   | 3   | 3   | 2   | 2   | -   | -   | 1   | 2   | 1    | -    | 1    | 3    | 3    | 2    |
| CO2              | 3   | 3   | 3   | 2   | 2   | -   | -   | 1   | 2   | 1    | -    | 1    | 3    | 3    | 2    |
| CO3              | 3   | 3   | 3   | 2   | 2   | -   | -   | 1   | 2   | 1    | -    | 1    | 3    | 3    | 2    |
| CO4              | 3   | 3   | 3   | 2   | 2   | -   | -   | 1   | 2   | 1    | -    | 1    | 3    | 3    | 2    |
| CO5              | 3   | 3   | 3   | 2   | 2   | -   | -   | 1   | 2   | 1    | -    | 1    | 3    | 3    | 2    |
| <b>22NPC727</b>  | 3   | 3   | 3   | 2   | 2   | -   | -   | 1   | 2   | 1    | -    | 1    | 3    | 3    | 2    |

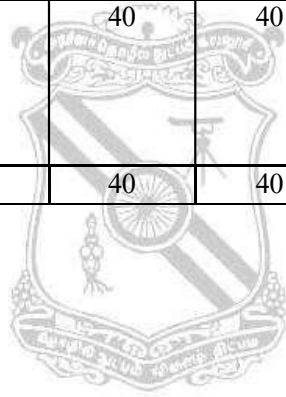
| b) CO and Key Performance Indicators mapping |                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.4, 2.3.1, 2.3.2, 2.4.1, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 5.1.1, 5.2.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.2.1, 10.3.1, 12.1.1 |
| CO2                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.4, 2.3.1, 2.3.2, 2.4.1, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 5.1.1, 5.2.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.2.1, 10.3.1, 12.1.1 |
| CO3                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.4, 2.3.1, 2.3.2, 2.4.1, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 5.1.1, 5.2.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.2.1, 10.3.1, 12.1.1 |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                                                                                                                                                                                                                                                                                                                                  |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO4 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 5.1.1, 5.2.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.2.1, 10.3.1, 12.1.1 |
| CO5 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.3, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 5.1.1, 5.2.1, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.2.1, 10.3.1, 12.1.1 |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                          | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|----------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                           |                   | 20                   | 40             | 40              |                   |                 | 100     |
| CAT2                                                           |                   | 20                   | 40             | 40              |                   |                 | 100     |
| Individual Assessment 1 / Case Study 1 / Seminar 1 / Project 1 |                   | 20                   | 40             | 40              |                   |                 | 100     |
| Individual Assessment 2 / Case Study 2 / Seminar 2 / Project 2 |                   | 20                   | 40             | 40              |                   |                 | 100     |
| ESE                                                            |                   | 20                   | 40             | 40              |                   |                 | 100     |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                  |                     |
|-----------------|--------------------------------------------------|---------------------|
| <b>22NEE701</b> | <b>ENGINEERING PROJECTS IN COMMUNITY SERVICE</b> | <b>SEMESTER VII</b> |
|-----------------|--------------------------------------------------|---------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>EEC</b>      | <b>0</b> | <b>0</b> | <b>4</b> | <b>2</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>To provide an environment where teams of students can exercise their engineering skills by being exposed to realistic systems and customers and at the same time helping their community.</li> </ul> |
| <p>Problem identification – Identifying the issues within the community -Preliminary survey - Preparing a questionnaire, formats and survey forms. - A preliminary survey including the socio-economic conditions of the allotted habitation - Different types of surveys, tools and techniques for collecting the information. - Analysis of collected data and mapping of issues with the solutions available. - Based on the survey and the specific requirements of the habitation, Community Awareness Campaigns – Identifying the factors – Normalization of factors and finding the path way for problem solution – Selection of problem from the community and mapping of issues - Planning for working: Aim, objective and scope, time line - Application of engineering knowledge and tools for solutions</p> <p>Validation of the solution by supervising the execution of solution - Measuring the attainment of the solution: Feedback from community</p> |                                                                                                                                                                                                                                             |
| <p><b>Contact Periods: 90 Periods</b><br/> <b>Lecture: 0 Periods      Tutorial: 0 Periods      Practical: 60 Periods      Total: 60 Periods</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                             |

| <b>COURSE OUTCOMES</b>                                      |                                                                                            | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to |                                                                                            |                                |
| CO1                                                         | Identify engineering related problems in the community.                                    | K2                             |
| CO2                                                         | Analyze and Design different solutions to solve the problems of community.                 | K4                             |
| CO3                                                         | Apply economical solution to those problems in the field.                                  | K4                             |
| CO4                                                         | To understand complexity and ambiguity                                                     | K1                             |
| CO5                                                         | Connections with professionals and community members for learning and career opportunities | K2                             |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b> |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                     | -   | 2   | 2   | -   | 1   | 2   | 1   | -   | 2   | -    | 1    | -    | 1    | 1    | 1    |
| CO2                     | -   | 2   | 2   | -   | 1   | 2   | 1   | -   | 2   | -    | 1    | -    | 1    | 1    | 1    |
| CO3                     | -   | 2   | 2   | -   | 1   | 2   | 1   | -   | 2   | -    | 1    | -    | 1    | 1    | 1    |
| CO4                     | -   | 2   | 2   | -   | 1   | 2   | 1   | -   | 2   | 2    | 1    | -    | 1    | 1    | 1    |
| CO5                     | -   | 2   | 2   | -   | 1   | 2   | 1   | -   | 2   | 2    | 1    | -    | 1    | 1    | 1    |
| <b>22NEE701</b>         | -   | 2   | 2   | -   | 1   | 2   | 1   | -   | 2   | 1    | 1    | -    | 1    | 1    | 1    |



|                 |                         |                      |
|-----------------|-------------------------|----------------------|
| <b>22NEE803</b> | <b>CAPSTONE PROJECT</b> | <b>SEMESTER VIII</b> |
|-----------------|-------------------------|----------------------|

| PREREQUISITES | CATEGORY | L | T | P  | C |
|---------------|----------|---|---|----|---|
| NIL           | EEC      | 0 | 0 | 16 | 8 |

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | <ul style="list-style-type: none"> <li>To identify a topic of interest in consultation with Faculty/Supervisor, review the literature and gather information pertaining to the chosen topic, state the objectives and develop a methodology to achieve the objectives, carry out the design/fabrication or develop codes/programs to achieve the objectives and demonstrate the novelty of the project through the results and outputs.</li> </ul> |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

There shall be three reviews during the semester. The student shall make a presentation on the progress made by him / her before the “Project Review Committee”. The HOD shall constitute a “Project Review Committee” for each Programme. There shall be a minimum of three members in the Review Committee. The Project Guide will be one of the members of the Review Committee. The student(s) is expected to submit the Project Report on or before the notified date. The End Semester Examination for Project Work shall consist of evaluation of the final Project Report submitted by the student(s) of the Project group and viva-voce examination by an external examiner and internal examiner.

ContactPeriods:240Periods

**Lecture:0Periods**

## Tutorial:0Periods

**Practical:240PeriodsTotal:240Periods**

| COURSE OUTCOMES                                             |                                                                                                                                               | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Upon completion of the course, the students will be able to |                                                                                                                                               |                         |
| CO1                                                         | Select a problem statement and be able to develop a solution methodology to achieve the objectives which impacts the society and environment. | K5                      |
| CO2                                                         | Conduct investigations on solution methodology to develop hardware/software products utilizing state-of-the-art technologies.                 | K5                      |
| CO3                                                         | Prepare a good technical report and be able to present the ideas with clarity.                                                                | K3                      |
| CO4                                                         | Work efficiently as a member of different teams related to multidisciplinary projects.                                                        | K2                      |
| CO5                                                         | Acquire skills to communicate efficiently and gain management skills related to industry and research organizations.                          | K3                      |

## COURSE ARTICULATION MATRIX

[illegible]

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING****b) CO and Key Performance Indicators mapping**

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.3, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |
| CO2 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2, 4.3.1, 4.3.2, 4.3.3, 4.3.4, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.3, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |
| CO3 | 1.2.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.1, 4.1.1, 4.1.2, 4.3.3, 5.1.1, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2                                                                                                                                     |
| CO4 | 1.2.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.1, 4.1.1, 4.1.2, 4.3.3, 5.1.1, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2                                                                                                                                     |
| CO5 | 1.2.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.5, 3.3.1, 4.1.1, 4.1.2, 4.3.3, 5.1.1, 5.1.2, 6.1.1, 7.1.1, 7.1.2, 8.1.1, 8.2.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2                                                                                                                                     |



|                 |                                |
|-----------------|--------------------------------|
| <b>22NPES01</b> | <b>ADVANCED CONTROL THEORY</b> |
|-----------------|--------------------------------|

| <b>PREREQUISITES</b>                    | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|-----------------------------------------|-----------------|----------|----------|----------|----------|
| <b>22NPC513 - CONTROL SYSTEM DESIGN</b> | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                       |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                      | To instill the proficiency of controller design, state variable and phase plane analysis and need of optimal control. |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                              | <b>CONTROLLER DESIGN AND STATE SPACE ANALYSIS</b>                                                                     | <b>9 Periods</b> |
| System performance and specifications – Feedback compensators – Proportional Derivative (PD), Proportional Integral (PI) and PID controllers -Design of PD,PI,PID controllers (cascade)using time and Frequency domain methods.                                                                                                                                              |                                                                                                                       |                  |
| Concepts of state, state variable and state space model- State space representation of discrete time systems-solutions of state equations- state transition matrix.                                                                                                                                                                                                          |                                                                                                                       |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                             | <b>CONTROLLABILITY AND OBSERVABILITY</b>                                                                              | <b>9 Periods</b> |
| BIBO Stability – Determining the stability by Routh-Hurwitz criterion- Properties and construction of the root loci-effect of adding a pole and zeros to a system. Jordan and Canonical forms, Controllability and observability - Condition for controllability and observability, Gilbert method and Kalman decomposition- Design of state feedback by pole placement.     |                                                                                                                       |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                            | <b>NON-LINEAR CONTROL</b>                                                                                             | <b>9 Periods</b> |
| Non-linear systems-properties-common physical nonlinearities - dead zone, relay, saturation nonlinearities Phase plane analysis - isocline method, Delta method-Existence of limit cycles. Describing function fundamentals- Definitions-Assumptions-Computing describing functions-Nyquist criterion and its extension-Existence of limit cycles-Stability of limit cycles. |                                                                                                                       |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                             | <b>LYAPUNOV STABILITY</b>                                                                                             | <b>9 Periods</b> |
| Lyapunov direct method, positive definite functions and lyapunov functions, invariant set theorems, lyapunov analysis of linear time invariant systems, the variable gradient method, performance analysis, existence of Lyapunov functions.                                                                                                                                 |                                                                                                                       |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                              | <b>OPTIMAL CONTROL</b>                                                                                                | <b>9 Periods</b> |
| Problem formulation – necessary conditions of optimality – state regulator problem – Matrix Riccati equation – infinite time regulator problem – output regulator and tracking problems.                                                                                                                                                                                     |                                                                                                                       |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                           |                                                                                                                       |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                         |                                                                                                                       |                  |

**TEXT BOOKS:**

|   |                                                                                                                                        |
|---|----------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Nagarath, I.J. and Gopal, M., “ <b>Control Systems Engineering</b> ”, New Age International Publishers, 2 <sup>nd</sup> edition, 2017. |
| 2 | Kirk D.E, “ <b>Optimal control theory-an introduction</b> ”, Prentice Hall, Reprint edition, N.J. 2004.                                |

**REFERENCES:**

|   |                                                                                                                                                         |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Gopal M, “ <b>Modern Control Theory</b> ”, Wiley Eastern Publishers, 2 <sup>nd</sup> edition ,1993.                                                     |
| 2 | Tou T.J. “ <b>Modern control theory</b> ”, McGraw-Hill publications, Reprint edition, 1964.                                                             |
| 3 | Torkel Glad & Lennart Ljung “ <b>Control Theory - Multi Variable and Non-linear Methods</b> ” Taylor’s & Francis Group, ,2 <sup>nd</sup> edition ,2002. |
| 4 | Hasan Saeed.S, “ <b>Automatic Control Systems</b> ” S.K. Kataria & Sons, Reprint edition, 2013.                                                         |
| 5 | Ogata K.H “ <b>State Space Analysis of Control Systems</b> ”, Prentice Hall Publications, 1 <sup>st</sup> Edition, 1967.                                |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                    | <b>Bloom's Taxonomy Mapped</b> |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------|
| CO1                                                                                   | Design cascade controllers and feedback compensators in time and frequency domain. | K3                             |
| CO2                                                                                   | Develop and derive state space models for various systems.                         | K3                             |
| CO3                                                                                   | Familiarize Nonlinearities and Describing functions.                               | K4                             |
| CO4                                                                                   | Describe the common non-linearities and its stability.                             | K3                             |
| CO5                                                                                   | Explain the need of optimality.                                                    | K3                             |

## COURSE ARTICULATION MATRIX

| <b>CO/PO Mapping</b>                                |                                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                             | PO1                                  | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 3                                    | 3        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO2                                                 | 3                                    | 3        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO3                                                 | 3                                    | 2        | 2        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO4                                                 | 3                                    | 2        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO5                                                 | 3                                    | 2        | 2        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| <b>22NPES01</b>                                     | <b>3</b>                             | <b>3</b> | <b>3</b> | <b>2</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>-</b> | <b>2</b> | <b>1</b> |
| <b>b) CO and Key Performance Indicators mapping</b> |                                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 20                   | 40             | 30              |                   |                 | 100     |
| CAT2                                                         | 10                | 20                   | 40             | 30              |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   |                      | 50             | 50              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   |                      | 50             | 50              |                   |                 | 100     |
| ESE                                                          | 10                | 20                   | 40             | 30              |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                  |                                         |
|------------------|-----------------------------------------|
| <b>22NPE\$02</b> | <b>PROCESS MODELLING AND SIMULATION</b> |
|------------------|-----------------------------------------|

| PREREQUISITES                                  | CATEGORY  | L        | T        | P        | C        |
|------------------------------------------------|-----------|----------|----------|----------|----------|
| <b>22NPC620 - PROCESS DYNAMICS AND CONTROL</b> | <b>PE</b> | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                        |                  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | To provide the fundamentals of modelling techniques of process and simulation software for estimation. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>FUNDAMENTALS OF PROCESS MODELLING</b>                                                               | <b>9 Periods</b> |  |
| Use and scope of mathematical modeling, Principles of model formulation, Role and importance of steady-state and dynamic simulation, Classification of models, Black-Box model, White Box model, Gray model, classification of mathematical methods. Modeling difficulties, Selection of design variables.                                                                                                                                                                                   |                                                                                                        |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>MODELING OF DISTRIBUTED PROCESSES</b>                                                               | <b>9 Periods</b> |  |
| Steady state models giving rise to Differential Algebraic Equation (DAE) systems; Rate based Approaches for staged processes; Modeling of differential contactors – distributed parameter models of packed beds; Packed bed reactors; Modeling of reactive separation processes; Review of solution strategies for Differential Algebraic Equations, Partial Differential Equations (PDEs), and available numerical software libraries.                                                      |                                                                                                        |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>INTRODUCTION TO PROCESS MODELLING</b>                                                               | <b>9 Periods</b> |  |
| Concept of degree of freedom analysis: System and its subsystem, System interaction, Degree of freedom in a system e.g. Heat exchanger, Equilibrium still, Reversal of information flow, Design variable selection algorithm, Information flow through subsystems, Structural effects of design variable selection, Persistent Recycle.                                                                                                                                                      |                                                                                                        |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>MODELLING OF INDUSTRIAL PROCESS</b>                                                                 | <b>9 Periods</b> |  |
| Constant and variable holdup CSTRs under isothermal and non-isothermal conditions, Stability analysis, Gas phase pressurized CSTR, Two phase CSTR, Non-isothermal PFR, Batch and semi-batch reactors, Heat conduction in a bar, Laminar flow of Newtonian liquid in a pipe, Gravity flow tank, Single component vaporizer, Multicomponent flash drum, Absorption column, Ideal binary distillation column and non ideal multi-component distillation column, Batch distillation with holdup. |                                                                                                        |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>SIMULATION TECHNIQUES</b>                                                                           | <b>9 Periods</b> |  |
| Simulation of the models, Sequential modular approach, Equation oriented approach, Partitioning and tearing, Kinetic Monte Carlo Simulation. Introduction and use of process simulation software (Aspen Plus/ Aspen Hysys) for flow sheet simulation.                                                                                                                                                                                                                                        |                                                                                                        |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                        |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                        |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Luyben W.L., “ <b>Process Modeling, Simulation, and Control for Chemical Engineering</b> ”, 7 <sup>th</sup> edition, McGraw-Hill (2018)                       |
| 2 | Holland, “ <b>Fundamentals and Modeling of Separation Processes: Absorption, Distillation</b> ” 3 <sup>rd</sup> edition, Englewood Cliffs, Prentice-Hall 2014 |

**REFERENCES:**

|   |                                                                                                                                                    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | A. K. Jana “ <b>Chemical Process Modelling and Computer Simulation</b> ”, Prentice Hall India 3 <sup>rd</sup> Edition, 2018                        |
| 2 | JumaHaydary “ <b>Chemical Process Design and Simulation - Aspen Plus and Aspen HYSYS Applications</b> ”, 5 <sup>th</sup> edition, Wiley, 2019      |
| 3 | Babatunde Ogunnaike and W. Harmon Ray, “ <b>Process Dynamics, Modeling, and Control</b> ”, 1 <sup>st</sup> Edition, Oxford University Press, 1994. |
| 4 | Simant Ranjan Upreti, “ <b>Process Modeling and simulation for Chemical Engineers</b> ” 7 <sup>th</sup> edition, John Wiley & Sons Ltd, 2017       |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                   | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Explain the first principle, grey box and empirical model for a given system      | K2                                     |
| CO2                                                                                   | Derive the mathematical models by applying relevant modelling techniques          | K3                                     |
| CO3                                                                                   | Perform analysis and subsequent conclusion for the developed mathematical models. | K4                                     |
| CO4                                                                                   | Comprehend the different methods of developing models for industrial processes    | K3                                     |
| CO5                                                                                   | Simulate the mathematical models using relevant software                          | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                                                                                                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                                                                                                                                      | 3   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3    |
| CO2                                                 | 3                                                                                                                                                                                                      | 3   | 1   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3    |
| CO3                                                 | 3                                                                                                                                                                                                      | 3   | 2   | 3   | 1   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3    |
| CO4                                                 | 3                                                                                                                                                                                                      | 3   | 2   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3    |
| CO5                                                 | 2                                                                                                                                                                                                      | 3   | 1   | 2   | 1   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3    |
| <b>22NPE\$02</b>                                    | 3                                                                                                                                                                                                      | 3   | 2   | 3   | 1   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.2.1,3.2.3,4.1.3,4.1.4,4.2.2,4.3.1,4.3.2,4.3.3,5.1.1,5.2.1,5.2.2                    |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.3,1.4.3,2.3,4.1.3,,4.2.1,4.3.1,4.3.2                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.3,3.2.1,3.2.2,,3.2.3,3.4.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.3,3.2.1,3.2.2,,3.2.3,3.4.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,6.1   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.3,3.2.1,,3.2.3,4.1.2,4.1.3,4.1.4,4.2.2,4.3.1,4.3.2,4.3.3,5.1.1                   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 30                | 30                   | 40             |                 |                   |                 | 100     |
| CAT2                                                         | 30                | 30                   | 40             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 20                   | 40             | 40              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 20                   | 40             | 40              |                   |                 | 100     |
| ESE                                                          | 30                | 30                   | 40             |                 |                   |                 | 100     |

|                 |                                      |
|-----------------|--------------------------------------|
| <b>22NPES03</b> | <b>COMPUTER CONTROL OF PROCESSES</b> |
|-----------------|--------------------------------------|

| <b>PREREQUISITES:</b>                                                                                       | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|-------------------------------------------------------------------------------------------------------------|-----------------|----------|----------|----------|----------|
| 1. <b>22NBS408 FOURIER SERIES AND TRANSFORM CALCULUS</b><br>2. <b>22NPC620 PROCESS DYNAMICS AND CONTROL</b> | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                               |                                                                                                                  |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                       | To embed the necessity and design of computer controlled process and its variants via digital control algorithms |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                               | <b>SAMPLED DATA CONTROL SYSTEM</b>                                                                               | <b>9 Periods</b> |  |
| Introduction – Review of Z transform – Modified Z transform – Need of computer in a control system – Functional block diagram of a computer control system – Direct digital control (DDC) – Supervisory control– Data logger –SCADA.                                                          |                                                                                                                  |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                              | <b>SYSTEM MODELLING AND IDENTIFICATION</b>                                                                       | <b>9 Periods</b> |  |
| Introduction to pulse transfer function – open loop and closed loop response of Sampled Data Systems – Pulse testing for process identification – linear least square algorithm – implementation of digital controllers: Temperature control system, Position control system, Stepper motors. |                                                                                                                  |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                             | <b>DESIGN OF DIGITAL CONTROL ALGORITHM</b>                                                                       | <b>9 Periods</b> |  |
| Design and implementation of different digital control algorithm: Dead beat, Dahlin, Kalman's algorithm, Pole placement controller, Position and velocity form algorithm – selection of sampling time – Smith predictor algorithm – Jury's stability test – Schur Cohn stability criterion.   |                                                                                                                  |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                              | <b>ADAPTIVE CONTROL</b>                                                                                          | <b>9 Periods</b> |  |
| Concepts: Self tuning – Gain scheduling – Model Reference Adaptive Control – Self tuning regulator - – Design of auto tuning and gain scheduling adaptive controller with examples.                                                                                                           |                                                                                                                  |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                               | <b>MULTI VARIABLE CONTROL SYSTEM</b>                                                                             | <b>9 Periods</b> |  |
| Multi variable Control- Transfer matrix representation- poles and zeros of MIMO system- Multi loop control- Process Interaction-Pairing of inputs and outputs- Relative Gain array (RGA)- Multivariable PID control.                                                                          |                                                                                                                  |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                            |                                                                                                                  |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                          |                                                                                                                  |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------|
| 1 | Dale Seborg. E, Thomas. F, Edgar, Duncan. A, Mellichamp, " <b>Process Dynamics and Control</b> ", Willey India, 2006. |
| 2 | Astrom .K. J, Bjorn Wittenmark, " <b>Adaptive Control</b> ", 2 <sup>nd</sup> Edition, Prentice Hall of India, 2004.   |
| 3 | Deshpande. Pm, and Ash, " <b>Elements of Computer Control System</b> ", ISA Press, USA, 1998.                         |

**REFERENCES:**

|   |                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Bequette, B.W., " <b>Process Control Modeling, Design and Simulation</b> ", Prentice Hall of India, 2008.                           |
| 2 | Thomas E. Marlin, " <b>Process Control – Designing Processes and Control systems for Dynamic Performance</b> ", Mc-Graw-Hill, 2000. |
| 3 | Stephanopoulos, G., " <b>Chemical Process Control -An Introduction to Theory and Practice</b> ", Prentice Hall of India, 2005.      |
| 4 | Sigurd Skogestad, Ian Postlethwaite, " <b>Multivariable Feedback Control: Analysis and Design</b> ", John Wiley and Sons, 2005.     |
| 5 | P. Albertos and A. Sala, " <b>Multivariable Control Systems An Engineering Approach</b> ", Springer Verlag, 2006.                   |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b>                                      |                                                                                  | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                  |                                |
| CO1                                                         | Elaborate the need of computers in direct digital and supervisory control system | K2                             |
| CO2                                                         | Describe various algorithms in system modeling and identification                | K2                             |
| CO3                                                         | Design and implement different control algorithms for digital controllers        | K3                             |
| CO4                                                         | Describe the concepts of adaptive control techniques.                            | K3                             |
| CO5                                                         | Explain the essentials of multivariable control system.                          | K2                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                           |     |     |     |     |     |     |     |     |      |      |      |      |      |          |
|-----------------------------------------------------|-------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|----------|
| COs/POs                                             | PO1                                       | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3     |
| CO1                                                 | 3                                         | 1   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 2        |
| CO2                                                 | 3                                         | 2   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 2        |
| CO3                                                 | 3                                         | 2   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 2        |
| CO4                                                 | 3                                         | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3        |
| CO5                                                 | 3                                         | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 3        |
| <b>22NPES03</b>                                     | 3                                         | 3   | 3   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | <b>3</b> |
| <b>b) CO and Key Performance Indicators mapping</b> |                                           |     |     |     |     |     |     |     |     |      |      |      |      |      |          |
| CO1                                                 | 1.1.1,.1.1.2, 1.2,1, 1.2.,2, 2.1.1,2.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |          |
| CO2                                                 | 1.1.1,.1.1.2, 1.2,1, 1.2.,2, 2.1.1,2.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |          |
| CO3                                                 | 1.1.1,.1.1.2, 1.2,1, 1.2.,2, 2.1.1,2.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |          |
| CO4                                                 | 1.1.1,.1.1.2, 1.2,1, 1.2.,2, 2.1.1,2.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |          |
| CO5                                                 | 1.1.1,.1.1.2, 1.2,1, 1.2.,2, 2.1.1,2.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |          |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                | 50                   | 30             |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 50                   | 30             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 50                   | 30             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 50                   | 30             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 50                   | 30             |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                              |
|-----------------|------------------------------|
| <b>22NPES04</b> | <b>SYSTEM IDENTIFICATION</b> |
|-----------------|------------------------------|

| <b>PREREQUISITES</b>                    | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|-----------------------------------------|-----------------|----------|----------|----------|----------|
| <b>22NPC513 - CONTROL SYSTEM DESIGN</b> | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                              |                  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                      | To explore the concept of estimating the parameters of the Input-output models using parameter estimation algorithms, the various closed loop system identification techniques and to elaborate the concept of estimating the state variables of a system using state estimation algorithms, |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                              | <b>ESTIMATORS</b>                                                                                                                                                                                                                                                                            | <b>9 Periods</b> |  |
| Transient analysis - frequency analysis - Correlation analysis - Spectral analysis.-Introduction, Development of parameter estimators, Least-Squares estimation – linear least-squares, generalized least-squares, nonlinear least-squares, Sufficient statistics, Analysis of estimation errors, MMSE, MAP and ML estimators, sequential least-squares, asymptotic properties, General convergence results. |                                                                                                                                                                                                                                                                                              |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>INTRODUCTION TO SYSTEM IDENTIFICATION</b>                                                                                                                                                                                                                                                 | <b>9 Periods</b> |  |
| Identification based on differential equations, Laplace transforms, frequency responses, difference equations. Stationarity, auto-correlation, cross-correlation, power spectra. Random and deterministic signals for system identification: pulse, step, pseudo random binary sequence (PRBS), signal spectral properties, persistent excitation.                                                           |                                                                                                                                                                                                                                                                                              |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                            | <b>IDENTIFICATION METHODS</b>                                                                                                                                                                                                                                                                | <b>9 Periods</b> |  |
| Estimates of the plant impulse, step and frequency responses from identification data, Correlation and spectral analysis for non-parametric model identification, parametric Models-Equation error, output error models, and determination of model order.                                                                                                                                                   |                                                                                                                                                                                                                                                                                              |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>MODEL ESTIMATION</b>                                                                                                                                                                                                                                                                      | <b>9 Periods</b> |  |
| Parametric estimation using one-step ahead prediction error model structures and estimation techniques for ARX, ARMAX, Box-Jenkins, FIR, Output Error models. Residual analysis for determining adequacy of the estimated models.                                                                                                                                                                            |                                                                                                                                                                                                                                                                                              |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                              | <b>RECURSIVE SYSTEM IDENTIFICATION</b>                                                                                                                                                                                                                                                       | <b>9 Periods</b> |  |
| Recursive system identification. Kalman filtering and other nonlinear filters                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                              |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                              |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                              |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Torsten Soderstrom, PetreStoica, " <b>System Identification</b> ", Prentice Hall International Ltd., 1 <sup>st</sup> edition, 1989. |
| 2 | Lennart Ljung, " <b>System Identification: Theory for the user</b> ", Prentice Hall, 2 <sup>nd</sup> edition, 1999.                 |

**REFERENCES:**

|   |                                                                                                                                                                                                                                      |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Karel J. Keesman, " <b>System Identification an Introduction</b> ", Springer, 1 <sup>st</sup> edition, 2011,                                                                                                                         |
| 2 | ArunK.Tangirala, " <b>Principles of System Identification: Theory and Practice</b> ", CRC Press, 1 <sup>st</sup> edition, 2014.                                                                                                      |
| 3 | Tao Liu and Furong Gao, " <b>Industrial Process Identification and control design, Step-test and relay-experiment-based methods</b> ", Springer- Verlag London Ltd., 1 <sup>st</sup> Edition., 2012.                                 |
| 4 | Van der Heijden, F., Duin, R.P.W., De Ridder, D., and Tax, D.M.J., " <b>Classification, Parameter Estimation and State Estimation-An Engineering Approach Using MATLAB</b> ", John Wiley & Sons Ltd., 2 <sup>nd</sup> Edition, 2017. |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                               | <b>Bloom's Taxonomy Mapped</b> |
|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------|
| CO1                                                                                   | Select suitable inputs and generate data for system identification.                           | K2                             |
| CO2                                                                                   | Establish model structure and order determination for an unknown process from empirical data. | K3                             |
| CO3                                                                                   | Explain estimation techniques for parametric and nonparametric models.                        | K2                             |
| CO4                                                                                   | Diagnose and validate the model for practical process applications.                           | K3                             |
| CO5                                                                                   | Explore nonlinear filters.                                                                    | K2                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                            |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|--------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                             | PO1                                        | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 3                                          | 3        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO2                                                 | 3                                          | 3        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO3                                                 | 3                                          | 2        | 2        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO4                                                 | 3                                          | 2        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO5                                                 | 3                                          | 2        | 2        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| <b>22NPES04</b>                                     | <b>3</b>                                   | <b>3</b> | <b>3</b> | <b>2</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>-</b> | <b>2</b> | <b>1</b> |
| <b>b) CO and Key Performance Indicators mapping</b> |                                            |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                                 | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                                 | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                                 | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                                 | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                                 | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 20                   | 60             |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 30                   | 50             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 50             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 50             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 40                   | 40             |                 |                   |                 | 100     |

|                 |                           |
|-----------------|---------------------------|
| <b>22NPES05</b> | <b>NON LINEAR CONTROL</b> |
|-----------------|---------------------------|

| <b>PREREQUISITES</b>                    | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|-----------------------------------------|-----------------|----------|----------|----------|----------|
| <b>22NPC513 - CONTROL SYSTEM DESIGN</b> | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                         |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                           | To gain understanding and elaborate the characteristics of nonlinear systems and to introduce the notion of complex systems theory and large-scale real world problems. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                   | <b>PHASE PLANE ANALYSIS</b>                                                                                                                                             | <b>9 Periods</b> |  |
| Concepts of phase plane analysis- Phase portraits- singular points- Symmetry in phase plane portraits- Constructing Phase Portraits- Phase plane Analysis of Linear and Nonlinear Systems                                                                                                                                                                                                         |                                                                                                                                                                         |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                  | <b>DESCRIBING FUNCTION</b>                                                                                                                                              | <b>9 Periods</b> |  |
| Describing Function Fundamentals-Definitions-Assumptions-Computing Describing Functions-Common Nonlinearities and its Describing Functions-Nyquist Criterion and its Extension-Existence of Limit Cycles-Stability of limit Cycles                                                                                                                                                                |                                                                                                                                                                         |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                 | <b>LYAPUNOV THEORY</b>                                                                                                                                                  | <b>9 Periods</b> |  |
| Nonlinear Systems and Equilibrium Points-Concepts of Stability-Linearization and Local Stability- Lyapunov's Direct Method-Positive definite Functions and Lyapunov Functions-Equilibrium Point Theorems-Invariant Set Theorems-LTI System Analysis based on Lyapunov's Direct Method- Krasovski's Method-Variable Gradient Method-Physically – Control Design based on Lyapunov's Direct Method. |                                                                                                                                                                         |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                  | <b>FEEDBACK LINEARIZATION</b>                                                                                                                                           | <b>9 Periods</b> |  |
| Feedback Linearization and the Canonical Form-Mathematical Tools-Input-State Linearization of SISO Systems- input-output Linearization of SISO Systems-Generating a Linear Input-Output Relation - Normal Forms, Zero-Dynamics - Stabilization and Tracking-Inverse Dynamics and Non-Minimum Phase Systems.                                                                                       |                                                                                                                                                                         |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                   | <b>SLIDING MODE CONTROL</b>                                                                                                                                             | <b>9 Periods</b> |  |
| sliding mode control:concept of a manifold, sliding surface,sliding mode motion and Method of equivalent control Chattering Problem, Sliding Surfaces- Continuous approximations of Switching Control laws-e Modeling/Performance Trade-Offs- SISO Systems.                                                                                                                                       |                                                                                                                                                                         |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                         |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                              |                                                                                                                                                                         |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                                            |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Jitendra R Raol, Ramakalyan Ayyagari, " <b>Control Systems: Classical, Modern, and AI-Based Approaches</b> ",CRC Press (Taylor & Francis), 1 <sup>st</sup> Edition , 2019. |
| 2 | Khalil, H.K., " <b>Nonlinear Systems</b> ",3 <sup>rd</sup> Edition, Prentice Hall Englewood Cliffs, New Jersey,, 2002.                                                     |

**REFERENCES:**

|   |                                                                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Strogatz, S. H., " <b>Nonlinear Dynamics &amp; Chaos, with Applications to Physics, Biology, Chemistry and Engineering</b> ", Westview Press, 2 <sup>nd</sup> Edition,2014. |
| 2 | Jean-Jacques E. Slotine, " <b>Applied Nonlinear Control</b> ", Prentice Hall Englewood Cliffs, 1 <sup>st</sup> Edition,1991.                                                |
| 3 | T. Glad and L. Ljung,, " <b>Control Theory –Multivariable and Non-Linear Methods</b> ", Taylor & Francis,1 <sup>st</sup> Edition 2002.                                      |
| 4 | Vidyasagar.M, " <b>Nonlinear System Analysis</b> ", SIAM,2 <sup>nd</sup> edition, 2002.                                                                                     |
|   | T Thyagarajan , D Kalpana, " <b>Linear and Non-Linear System Theory</b> ", CRC Press, 1 <sup>st</sup> edition, 2023.                                                        |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                             | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Distinguish between linear and nonlinear systems and their behavior                         | K3                                     |
| CO2                                                                                   | Apply various graphical and analytical tools to describe and examine nonlinear systems      | K4                                     |
| CO3                                                                                   | Elaborate Lyapunov's theory.                                                                | K4                                     |
| CO4                                                                                   | Investigate a range of controller design techniques suitable for nonlinear control systems. | K3                                     |
| CO5                                                                                   | Design preliminaries of a Sliding Mode Controller                                           | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                            |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|--------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                             | PO1                                        | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 3                                          | 3        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO2                                                 | 3                                          | 3        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO3                                                 | 3                                          | 2        | 2        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO4                                                 | 3                                          | 2        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO5                                                 | 3                                          | 2        | 2        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| <b>22NPES05</b>                                     | <b>3</b>                                   | <b>3</b> | <b>3</b> | <b>2</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>-</b> | <b>2</b> | <b>1</b> |
| <b>b) CO and Key Performance Indicators mapping</b> |                                            |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                                 | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                                 | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                                 | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                                 | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                                 | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                | 20                   | 30             | 30              |                   |                 | 100     |
| CAT2                                                         | 20                | 20                   | 30             | 30              |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   |                      | 50             | 50              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   |                      | 50             | 50              |                   |                 | 100     |
| ESE                                                          | 10                | 20                   | 40             | 30              |                   |                 | 100     |

|                 |                                                           |
|-----------------|-----------------------------------------------------------|
| <b>22NPES06</b> | <b>ADAPTIVE CONTROL</b><br>(Common to EEE & EIE Branches) |
|-----------------|-----------------------------------------------------------|

| PREREQUISITES                    | CATEGORY | L | T | P | C |
|----------------------------------|----------|---|---|---|---|
| 22NPC513 - CONTROL SYSTEM DESIGN | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                             |                  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                            | To study the definition of adaptive control and methods of adaptation, the parameter identification of systems, the self-tuning of PID controllers based on parameter identification, the model reference adaptive control. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                    | <b>INTRODUCTION TO ADAPTIVE CONTROL SCHEMES</b>                                                                                                                                                                             | <b>9 Periods</b> |  |
| Introduction to adaptive control – Effects of process variations –Adaptive control schemes – Adaptive control problem – Non-parametric identification – Step response method – Impulse response method – Frequency response method.                                                |                                                                                                                                                                                                                             |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                   | <b>PARAMETRIC IDENTIFICATION</b>                                                                                                                                                                                            | <b>9 Periods</b> |  |
| Parametric Identification - Linear in parameter models - ARX - ARMAX - ARIMAX - Least square estimation - Recursive least square estimation - Extended least square estimation - Maximum likelihood estimation – Non-linear system identification – Pseudo random binary sequence. |                                                                                                                                                                                                                             |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                  | <b>SELF-TUNING REGULATOR</b>                                                                                                                                                                                                | <b>9 Periods</b> |  |
| Self-Tuning regulator- Deterministic indirect self-tuning regulators - Deterministic direct self-tuning regulators - Stochastic self-tuning regulators – Stochastic indirect self-tuning regulator.                                                                                |                                                                                                                                                                                                                             |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                   | <b>MODEL REFERENCE ADAPTIVE SYSTEM</b>                                                                                                                                                                                      | <b>9 Periods</b> |  |
| The MIT rule – Lyapunov theory – Design of model reference adaptive controller using MIT rule and Lyapunov theory – Relation between model reference adaptive controller and self-tuning regulator.                                                                                |                                                                                                                                                                                                                             |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                    | <b>TUNING OF CONTROLLERS AND CASE STUDIES</b>                                                                                                                                                                               | <b>9 Periods</b> |  |
| Tuning of Controllers and Case Studies- Design of gain scheduling controller – Auto-tuning of PID regulator – Stability analysis of adaptive controllers – Application of adaptive control in chemical reactor, distillation column and variable area tank system.                 |                                                                                                                                                                                                                             |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                             |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                               |                                                                                                                                                                                                                             |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                            |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Karl J. Astrom and Bjorn Wittenmark, " <i>Adaptive Control</i> ", Pearson Education , 2 <sup>nd</sup> edition, 2013.                                       |
| 2 | I. D. Landau, R. Lozano, and M. M.Saad, " <i>Adaptive Control: Algorithms, Analysis and Applications</i> ", 2 <sup>nd</sup> edition, Springer-Verlag, 1998 |

**REFERENCES:**

|   |                                                                                                                                                            |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Chalam, " <i>Adaptive Control Systems: Techniques and Applications</i> ", CRC Press, 1 <sup>st</sup> edition , 1987                                        |
| 2 | Landau, I.D., Lozano, R., MSaad, M., Karimi, A, " <i>Adaptive Control Algorithms, Analysis and Applications</i> ", Springer, 2 <sup>nd</sup> edition, 2011 |
| 3 | Gang Tao, " <i>Adaptive Control Design and Analysis</i> ", Wiley-IEEE Press, 1 <sup>st</sup> edition, 2003                                                 |
| 4 | Kumpati S. Narendra, Anuradha M. Annaswamy, " <i>Stable Adaptive Control Systems</i> ", Dover Publications, Illustrated edition, 2005.                     |

| <b>COURSE OUTCOMES</b>                                      |                                                                                        | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                        |                                |
| CO1                                                         | Interpret the effect of parameter variation and principle of adaptive control schemes. | K2                             |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|     |                                                                                                    |    |
|-----|----------------------------------------------------------------------------------------------------|----|
| CO2 | Categorize different parametric identification methods..                                           | K3 |
| CO3 | Comprehend Deterministic and Stochastic Self Tuning Regulators                                     | K2 |
| CO4 | Design of model reference adaptive controller.                                                     | K3 |
| CO5 | Devise a gain scheduling controller and analyze adaptive control schemes for industrial processes. | K3 |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping                             |                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------|--------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                      | PO1                                        | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                          | 3                                          | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -    | -    | 1    | -    | 2    | 1    |
| CO2                                          | 3                                          | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -    | -    | 1    | -    | 2    | 1    |
| CO3                                          | 3                                          | 3   | 2   | 3   | 1   | -   | -   | -   | -   | -    | -    | 1    | -    | 2    | 1    |
| CO4                                          | 3                                          | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -    | -    | 1    | -    | 2    | 1    |
| CO5                                          | 3                                          | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -    | -    | 1    | -    | 2    | 1    |
| 22NPE\$06                                    | 3                                          | 3   | 3   | 3   | 1   | -   | -   | -   | -   | -    | -    | 1    | -    | 2    | 1    |
| b) CO and Key Performance Indicators mapping |                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                          | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                          | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                          | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                          | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                          | 1.1.1,1.2.1,2.1.3,2.2.2,4.1.4,5.2.1,12.3.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 30                   | 50             |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 30                   | 50             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 50             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 50             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 40                   | 40             |                 |                   |                 | 100     |

|                 |                            |
|-----------------|----------------------------|
| <b>22NPES07</b> | <b>MODEL BASED CONTROL</b> |
|-----------------|----------------------------|

| <b>PREREQUISITES</b>                    | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|-----------------------------------------|-----------------|----------|----------|----------|----------|
| <b>22NPC513 - CONTROL SYSTEM DESIGN</b> | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                        |                                                                                    |                  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                | To introduce the concept of model predictive control and adaptive control schemes. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                        | <b>MODEL PREDICTIVE CONTROL SCHEMES</b>                                            | <b>9 Periods</b> |  |
| Model Predictive Control - Model Predictive Control Elements - Generalized Predictive Control Scheme – Multivariable Generalized Predictive Control Scheme – Multiple Model based Model Predictive Control Scheme      |                                                                                    |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                       | <b>MULTI VARIABLE CONTROL</b>                                                      | <b>9 Periods</b> |  |
| MIMO Systems-Multivariable Control- Transfer Matrix representation- Poles and Zeros of MIMO System -Multiloop Control- Relative Gain array (RGA)- Multivariable PID Control- Multivariable IMC-IMC PID                 |                                                                                    |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                      | <b>STATE SPACE BASED MODEL PREDICTIVE CONTROL</b>                                  | <b>9 Periods</b> |  |
| State space MPC - Deterministic formulation - State feedback control - Separation principle - Implementation of output feedback MPC - Review of Kalman Filters – State Observer Based Model Predictive Control Schemes |                                                                                    |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                       | <b>CONSTRAINED MODEL PREDICTIVE CONTROL</b>                                        | <b>9 Periods</b> |  |
| Constraints Handling: Amplitude Constraints and Rate Constraints –Constraints and Optimization – Constrained LQ Control Theory - Constrained Model Predictive Control Scheme                                           |                                                                                    |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                        | <b>ADAPTIVE CONTROL</b>                                                            | <b>9 Periods</b> |  |
| Adaptive Control-Gain Scheduling-Self tuning Regulators– Lyapunov Theory - Model Reference Adaptive Control – Adaptive Command Tracking – Robust Model Reference Adaptive Control Scheme                               |                                                                                    |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                     |                                                                                    |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                   |                                                                                    |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                          |
|---|--------------------------------------------------------------------------------------------------------------------------|
| 1 | Coleman Brosilow, Babu Joseph, <i>“Techniques of Model-Based Control”</i> , Prentice Hall, 1 <sup>st</sup> Edition, 2002 |
| 2 | E. F. Camacho, C. Bordons, <i>“Model Predictive Control”</i> , Springer, 2 <sup>nd</sup> Edition, 2013.                  |

**REFERENCES:**

|   |                                                                                                                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Paul Serban Agachi, Zoltan K. Nagy, Mircea Vasile Cristea, and Arpad Imre-Lucaci, <i>“Model Based Control Case Studies in Process Engineering”</i> , WILEY-VCH Verlag, 1 <sup>st</sup> Edition, 2006                |
| 2 | Ridong Zhang, Anke Xue Furong Gao, <i>“Model Predictive Control Approaches Based on the Extended State Space Model and Extended Non-minimal State Space Model”</i> , Springer Verlag, 1 <sup>st</sup> Edition, 2019 |
| 3 | J.A. Rossiter, <i>“Model-Based Predictive Control A Practical Approach”</i> , CRC Press, 1 <sup>st</sup> Edition, 2003                                                                                              |
| 4 | K.J. Astrom and B. J. Wittenmark, <i>“Adaptive Control”</i> , Pearson Education, 2 <sup>nd</sup> Edition, 2008.                                                                                                     |

| <b>COURSE OUTCOMES</b>                                      |                                                            | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                            |                                |
| CO1                                                         | Develop Model Predictive Control for industrial processes. | K2                             |
| CO2                                                         | Explain various MIMO controllers used in industries.       | K3                             |
| CO3                                                         | Implement state space based MPC for the given problem.     | K3                             |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                      |    |
|-----|------------------------------------------------------|----|
| CO4 | Analyze constrained model predictive control scheme. | K3 |
| CO5 | Design adaptive control for the given application.   | K3 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                  |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                              | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| CO2                                                 | 3                                                                                                | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| CO3                                                 | 3                                                                                                | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| CO4                                                 | 3                                                                                                | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| CO5                                                 | 3                                                                                                | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| <b>22NPE\$07</b>                                    | 3                                                                                                | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                  |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 60                   | 40             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 60                   | 40             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 60                   | 20             |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                  |
|-----------------|----------------------------------|
| <b>22NPES08</b> | <b>MACHINE MONITORING SYSTEM</b> |
|-----------------|----------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                              |                  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                        | To introduce the concept of condition-based monitoring for effective utilization of machines |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                | <b>MACHINE CONDITION MONITORING</b>                                                          | <b>9 Periods</b> |  |
| Maintenance principles – Failure Modes Effects and Criticality Analysis (FMECA)-Fault Diagnostics and Prognostics – Future of condition based monitoring – Introduction of Industry 4.0 in Machine Monitoring System.                                                                                                                                                                                                          |                                                                                              |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                               | <b>VIBRATION AND NOISE MONITORING</b>                                                        | <b>9 Periods</b> |  |
| Accelerometers : Basics, Mounting methods – Vibration Monitoring : Basics of Vibration ,Characteristics of Vibration systems – Mode shapes & Operational deflection shapes – Experimental Modal Analysis - Industrial issues - Laser based Vibration Monitoring - Machinery faults diagnosed by Vibration Analysis - Noise Monitoring : Basics of noise, Sound Field, Concept of dB and Audio Frequency Range, Noise Standards |                                                                                              |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                              | <b>SIGNAL PROCESSING IN MONITORING</b>                                                       | <b>9 Periods</b> |  |
| Time domain analysis - Frequency domain analysis : FFT analysis – Signal filtering - Cepstrum analysis – Hilbert Transform in condition monitoring                                                                                                                                                                                                                                                                             |                                                                                              |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                               | <b>MACHINERY MAINTENANCE</b>                                                                 | <b>9 Periods</b> |  |
| Maintenance strategies :Reactive, Preventive, and Predictive – Benefits of planned maintenance – Bath tub curve –Trends in Machine monitoring - Case Study : Condition Monitoring in Paper mill                                                                                                                                                                                                                                |                                                                                              |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                | <b>MACHINE LEARNING FOR CONDITION MONITORING</b>                                             | <b>9 Periods</b> |  |
| Machine Learning: Feature extraction and feature selection methods – Feature reduction – Classification techniques – Case studies of condition monitoring in Nuclear plant components, Distillation column.                                                                                                                                                                                                                    |                                                                                              |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                              |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                           |                                                                                              |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Cornelius Scheffer and Paresh Girdhar, “Practical Machinery Vibration Analysis and Predictive Maintenance”, Newnes, 1<sup>st</sup> Edition, 2004.</i> |
| 2 | <i>A. R. Mohanty, “Machinery Condition Monitoring: Principles and Practices”, CRC Press, 1<sup>st</sup> Edition, 2014</i>                                |

**REFERENCES:**

|   |                                                                                                                                 |
|---|---------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Stephen Marsland, “Machine Learning: An Algorithmic Perspective “, 2<sup>nd</sup> edition, CRC Press, 2014</i>               |
| 2 | <i>Collacot, “Mechanical Fault Diagnosis and Condition Monitoring”, Springer, 1<sup>st</sup> Edition, 2011</i>                  |
| 3 | <i>Davies, “Handbook of Condition Monitoring – Techniques and Methodology”, Chapman and Hall, 1<sup>st</sup> Edition, 1997.</i> |
| 4 | <i>BKN Rao, “Handbook of Condition Monitoring”, Elsevier, 1<sup>st</sup> edition, 1996</i>                                      |

| <b>COURSE OUTCOMES</b>                                      |                                                                                    | <b>Bloom’s Taxonomy Mapped</b> |
|-------------------------------------------------------------|------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                    |                                |
| CO1                                                         | Explain the basic concepts related to machine monitoring system and Industry 4.0   | K2                             |
| CO2                                                         | Identify the faulty component in a machine by analyzing the acquired vibration and | K2                             |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|     |                                                                                                                          |    |
|-----|--------------------------------------------------------------------------------------------------------------------------|----|
|     | noise signals.                                                                                                           |    |
| CO3 | Apply signal processing in machinery monitoring.                                                                         | K2 |
| CO4 | Choose the proper maintenance strategies and condition monitoring techniques for identification of failure in a machine. | K2 |
| CO5 | Describe the application of machine learning for condition monitoring.                                                   | K2 |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping                             |                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------|---------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                      | PO1                                                           | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                          | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | -    | 2    |
| CO2                                          | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | -    | 2    |
| CO3                                          | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | -    | 2    |
| CO4                                          | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | 2    |
| CO5                                          | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | -    | 2    |
| 22NPES08                                     | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| b) CO and Key Performance Indicators mapping |                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                | 70                   |                |                 |                   |                 | 100     |
| ESE                                                          | 30                | 70                   |                |                 |                   |                 | 100     |

|                 |                                               |
|-----------------|-----------------------------------------------|
| <b>22NPES09</b> | <b>FIBER OPTICS AND LASER INSTRUMENTATION</b> |
|-----------------|-----------------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                  |                                                                                                          |                  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                          | To impart knowledge on the characteristics, types and industrial application of optical fiber and Laser. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                  | <b>FUNDAMENTALS OF OPTICAL FIBER</b>                                                                     | <b>9 Periods</b> |  |
| Principles of light propagation through a fiber - Laws related to light propagation through fiber - Fiber manufacturing -Different types of fibers and its characteristics – Absorption losses – Scattering losses – Dispersion – Fiber termination : Connectors, splicer – Optical sources – Optical detectors. |                                                                                                          |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                 | <b>MEASUREMENT USING OPTICAL FIBER</b>                                                                   | <b>9 Periods</b> |  |
| Fiber optic sensors – Fiber optic instrumentation system - Different types of modulators- Measurement of Pressure, Temperature, Current, Voltage, Liquid level and Strain.                                                                                                                                       |                                                                                                          |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                | <b>CHARACTERISTICS OF LASER</b>                                                                          | <b>9 Periods</b> |  |
| Fundamental characteristics of lasers – Three level and four level lasers – Laser modes – Resonator Configuration – Q-switching and Mode Locking – Types of lasers : Gas lasers, Solid lasers, Liquid lasers, Semiconductor lasers, Excimer lasers , Vertical-Cavity Surface Emitting Laser (VCSEL).             |                                                                                                          |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                 | <b>MEASUREMENT USING LASER</b>                                                                           | <b>9 Periods</b> |  |
| Measurement of Distance, Length, Velocity, Acceleration, Environmental monitoring - Material processing : Laser heating, Welding, Melting and Trimming of material – Removal and Vaporization.                                                                                                                   |                                                                                                          |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                  | <b>HOLOGRAPHY AND MEDICAL APPLICATIONS OF LASER</b>                                                      | <b>9 Periods</b> |  |
| Holography : Basic principle , Methods , Holographic interferometry and application - Holography for Non-Destructive Testing (HNDDT), Medical applications of lasers , laser and tissue interaction - Laser instruments for surgery – Safety aspects                                                             |                                                                                                          |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                               |                                                                                                          |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                             |                                                                                                          |                  |  |

**TEXT BOOKS:**

|   |                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------|
| 1 | <i>Keiser, G., “Optical Fiber Communication”, McGraw-Hill, 3<sup>rd</sup> Edition, 2000.</i>          |
| 2 | <i>John F. Read “Industrial Applications of Lasers” Academic Press, 2<sup>nd</sup> Edition, 2008.</i> |

**REFERENCES:**

|   |                                                                                                                                                                          |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Eric Udd, William B.,and Spillman, Jr., “Fiber Optic Sensors: An Introduction for Engineers and Scientists”, John Wiley &amp; Sons, 2<sup>nd</sup> Edition, 2011.</i> |
| 2 | <i>John F. Ready “Industrial Applications of Lasers” Academic Press, 3<sup>rd</sup> Edition, 2012</i>                                                                    |
| 3 | <i>Monte Ross, “Laser Applications”, McGraw-Hill, 1<sup>st</sup> Edition, 1968</i>                                                                                       |
| 4 | <i>John M. Senior “Optical Fiber Communications: Principles And Practice” Pearson Education, 3<sup>rd</sup> Edition, 2009.</i>                                           |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                            | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Explain the basic concepts, different types and the losses involved in the optical fibers. | K2                                     |
| CO2                                                                                   | Analyze the application of the fiber optic sensors in industry.                            | K3                                     |
| CO3                                                                                   | Describe the fundamental characteristics and different types of laser.                     | K2                                     |
| CO4                                                                                   | Apply laser for the measurement of physical quantities.                                    | K2                                     |
| CO5                                                                                   | Explain the application of laser in holography and medical applications                    | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                      |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|----------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                  | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                    | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| CO2                                                 | 2                                                                    | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| CO3                                                 | 2                                                                    | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| CO4                                                 | 2                                                                    | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| CO5                                                 | 2                                                                    | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| <b>22NPES09</b>                                     | 2                                                                    | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                      |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.5, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 60                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                | 70                   |                |                 |                   |                 | 100     |
| ESE                                                          | 20                | 80                   |                |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                              |
|-----------------|------------------------------------------------------------------------------|
| <b>22NPES10</b> | <b>THERMAL POWER PLANT INSTRUMENTATION</b><br>(Common to EEE & EIE Branches) |
|-----------------|------------------------------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                               |                                                                                                            |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                       | To impart knowledge on the process variables, measurements and control loops used in thermal power plants. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                               | <b>METHODS OF POWER GENERATION</b>                                                                         | <b>9 Periods</b> |  |
| Methods of Power Generation: Hydro, Thermal, Nuclear, Solar and Wind – Importance of Instrumentation in Power Generation – Basic Building Block for all Types of Power Generation Plants - Details of Boiler Processes – P and I Diagram of Boiler - Cogeneration.                                                            |                                                                                                            |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                              | <b>MEASUREMENTS IN POWER PLANTS</b>                                                                        | <b>9 Periods</b> |  |
| Measurement of Feed Water Flow, Air Flow, Steam Flow and Coal Flow – Drum Level Measurement – Temperature Measurement- Steam Pressure Measurement.                                                                                                                                                                            |                                                                                                            |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                             | <b>ANALYZERS IN POWER PLANTS</b>                                                                           | <b>9 Periods</b> |  |
| Analysis of Impurities in Feed Water and Steam - Oxygen Analyzer - Dissolved Oxygen Analyzer - Chromatography - pH Meter - Fuel Analyzer - Flue Gas Analyzer – Pollution Monitoring Instruments.                                                                                                                              |                                                                                                            |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                              | <b>CONTROL LOOPS IN BOILER</b>                                                                             | <b>9 Periods</b> |  |
| Combustion Control: Air/Fuel Ratio Control, Furnace Draft Control - Drum Level Control - Main Steam and Reheat Steam Temperature Control - Superheater Control - Attemperator – Deaerator Control - Interlocks in Boiler Operation - Distributed Control System in Power Plants.                                              |                                                                                                            |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                               | <b>TURBINE AND ITS CONTROL</b>                                                                             | <b>9 Periods</b> |  |
| Types of Steam Turbines: Impulse and Reaction Turbines – Compounding – Turbine Governing System– Free Governor Mode Operation – Turbine Run up System – Turbine Speed and Vibration Measurement - Speed Control - Automatic Load Frequency Control – Safety Control System - Turbo Alternator lubrication and Cooling System. |                                                                                                            |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                            |                                                                                                            |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                          |                                                                                                            |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                             |
|---|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Sam Dukelow, " <b>Control of Boilers</b> ", Instrument Society of America, 2 <sup>nd</sup> Edition, 1991.                                   |
| 2 | Krishnaswamy, K. and Ponnibala.M, " <b>Power Plant Instrumentation</b> ", PHI Learning Pvt. Ltd., New Delhi, 2 <sup>nd</sup> Edition, 2014. |

**REFERENCES:**

|   |                                                                                                                            |
|---|----------------------------------------------------------------------------------------------------------------------------|
| 1 | Liptak B.G, " <b>Instrumentation in Process Industries</b> ", Chilton Book Company, 2005.                                  |
| 2 | Jain R.K, " <b>Mechanical and Industrial Measurements</b> ", Khanna Publishers, New Delhi, 11 <sup>th</sup> Edition, 1999. |
| 3 | Gill.A.B, " <b>Power Plant performance</b> ", Butterworth and Co (Publishers) Ltd, 2003.                                   |
| 4 | David Lindsley, " <b>Boiler Control Systems</b> ", Mc-Graw Hill, 1991.                                                     |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                               | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Explain the different methods of generating power                             | K2                                     |
| CO2                                                                                   | Select suitable instruments for various process measurements in power plants  | K2                                     |
| CO3                                                                                   | Describe the operation of different analysers used in power plants            | K2                                     |
| CO4                                                                                   | Analyze the control strategies implemented in different stages of power plant | K3                                     |
| CO5                                                                                   | Elaborate on the types of turbines, their related measurements and control    | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                   | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| CO2                                                 | 2                                                                                   | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| CO3                                                 | 2                                                                                   | 1   | 1   | 1   | -   | -   | 2   | -   | -   | -    | -    | -    | -    | 3    | -    |
| CO4                                                 | 2                                                                                   | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| CO5                                                 | 2                                                                                   | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | -    |
| <b>22NPES10</b>                                     | 2                                                                                   | 1   | 1   | 1   | -   | -   | 1   | -   | -   | -    | -    | -    | -    | 3    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1, 1.3.1, 1.4.1, 2.2.1, 2.2.2, 2.2.4, 2.4.3, 3.1.5, 3.1.6                       |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1, 1.3.1, 1.4.1, 2.2.1, 2.2.2, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 4.1.4.               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1, 1.3.1, 1.4.1, 2.2.1, 2.2.2, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 4.1.4, 7.1.1, 7.2.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1, 1.3.1, 1.4.1, 2.2.1, 2.2.2, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 4.1.4.               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1, 1.3.1, 1.4.1, 2.2.1, 2.2.2, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 4.1.4, 7.1.1         |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                | 80                   |                |                 |                   |                 | 100     |
| CAT2                                                         |                   | 80                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 100                  |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 60                   | 40             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 60                   | 20             |                 |                   |                 | 100     |

|                 |                                                                |
|-----------------|----------------------------------------------------------------|
| <b>22NPES11</b> | <b>INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES</b> |
|-----------------|----------------------------------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                               |                  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                            | To introduce the basic concepts of unit operations and control in the petrochemical industry. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>OIL EXTRACTION AND OIL GAS PRODUCTION</b>                                                  | <b>9 Periods</b> |  |
| Introduction to petroleum exploring, processing and refining - Constituents of crude oil-Techniques used for oil discovery – Oil recovery methods – oil rig system - Overview of oil gas production – oil gas separation – Gas treatment and compression – Control and safety systems.                                                                                             |                                                                                               |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                   | <b>IMPORTANT UNIT OPERATIONS IN REFINERY</b>                                                  | <b>9 Periods</b> |  |
| Distillation Column – Thermal cracking – Catalytic Cracking – Catalytic reforming – mathematical Modeling and selection of appropriate control strategy – Alkylation – Isomerization.                                                                                                                                                                                              |                                                                                               |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                  | <b>DISTILLATION COLUMNS &amp; REACTORS</b>                                                    | <b>9 Periods</b> |  |
| Instrumentation and control in distillation columns: distillation equipment- variable and degrees of freedom - measurement and control of column pressure - liquid distillate - Vapor distillate and inerts - Control of feed, Reboiler and Reflux - Temperature control and pressure control in batch reactors - Parameters to be measured in refinery and petrochemical industry |                                                                                               |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                   | <b>PROCESS SAFETY</b>                                                                         | <b>9 Periods</b> |  |
| Hazardous zone classification – Electrical and Intrinsic safety – Explosion suppression and Deluge systems – Flame, fire and smoke detectors – leak detectors – Guidelines and standards – General SIS Design Configurations – Hazard and Risk Assessment – Failure modes – Operation and Maintenance.                                                                             |                                                                                               |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>PETROLEUM DERIVATIVES AND WASTE WATER TREATMENT</b>                                        | <b>9 Periods</b> |  |
| Derivatives from methane – Methanol Production – Acetylene production – Derivatives from acetylene – Derivatives from ethylene-Derivatives from propylene - wastewater treatment : Chemical Oxidation , Reduction ,Neutralization and Precipitation                                                                                                                                |                                                                                               |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                 |                                                                                               |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                               |                                                                                               |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Bela. G. LIPTAK “Instrumentation in Processing Industries” Chilton Book Company, 1<sup>st</sup> Edition, 2012.</i> |
| 2 | <i>Considine D.M “Handbook Of Applied Instrumentation” McGraw Hill, 1<sup>st</sup> Edition, 1964</i>                  |

**REFERENCES:**

|   |                                                                                                                                             |
|---|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Goldstien R.F, Waddams A.L “Petroleum Chemicals Industry” Spon-Publisher, 3<sup>rd</sup> Edition, 1967</i>                               |
| 2 | <i>George.T. Austin “Shreve’s Chemical Process Industries”, McGraw Hill, 5<sup>th</sup> Edition, 1998.</i>                                  |
| 3 | <i>Balchan J.G and Mumme K.I “Process Control Structures and Applications” Van Nostrand Reinhold Company, 1<sup>st</sup> Edition, 1988.</i> |
| 4 | <i>Curtis D. Johnson “Process Control Instrumentation Technology”, Pearson Education, 17<sup>th</sup> Edition, 2002.</i>                    |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b>                                      |                                                                            | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                            |                                |
| CO1                                                         | Explain oil extraction and oil gas production process.                     | K2                             |
| CO2                                                         | Discuss the important unit operations in the refinery.                     | K2                             |
| CO3                                                         | Select appropriate control strategy for distillation columns and reactors. | K2                             |
| CO4                                                         | Describe the safety measures followed in process industries.               | K2                             |
| CO5                                                         | Recognize the steps involved in waste water treatment processes.           | K2                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                             |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-----------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                         | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                           | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | 2    |
| CO2                                                 | 2                                                                           | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | 2    |
| CO3                                                 | 2                                                                           | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | 2    |
| CO4                                                 | 2                                                                           | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | 2    |
| CO5                                                 | 2                                                                           | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | 2    |
| <b>22NPE\$11</b>                                    | 2                                                                           | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | 2    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                             |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.4, 3.1.5, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                | 70                   |                |                 |                   |                 | 100     |
| ESE                                                          | 30                | 70                   |                |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                 |
|-----------------|---------------------------------|
| <b>22NPES12</b> | <b>AIRCRAFT INSTRUMENTATION</b> |
|-----------------|---------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                 |                  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                            | To preface or open the concepts of aircraft systems and familiarize with the knowledge on aircraft instruments. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>AIRCRAFT SYSTEMS</b>                                                                                         | <b>9 Periods</b> |  |
| Hydraulic systems – Study of typical systems – components – Hydraulic systems controllers – Modes of operation – Pneumatic systems – Working principles – Typical Pneumatic Power system– Brake system: Components, Landing Gear Systems – Classification – Shock absorbers – Retractive mechanism.                                                                                |                                                                                                                 |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                   | <b>ENGINE AND AIR CONDITIONING SYSTEMS</b>                                                                      | <b>9 Periods</b> |  |
| Piston and Jet Engines- Fuel systems Components - Multi-engine fuel systems, lubricating system – Starting and Ignition systems. Basic Air Cycle system – Vapour Cycle System, Boot-strap air cycle system – Evaporative vapour cycle system – Evaporation air cycle system – Oxygen system – Fire extinguishing system and smoke detection system, Deicing and anti-icing system. |                                                                                                                 |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                  | <b>AIRCRAFT CONTROL SYSTEMS</b>                                                                                 | <b>9 Periods</b> |  |
| Operating principles: Conventional System – Power assisted and fully powered flight controls – Power actuated system – Engine control system – Push pull rod system – Modern control system – Digital fly by wire systems – Auto pilot system, Active Control Technology.                                                                                                          |                                                                                                                 |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                   | <b>AIR-DATA AND GYROSCOPIC INSTRUMENTS</b>                                                                      | <b>9 Periods</b> |  |
| Instrumentation – Altimeters - Vertical speed indicators – Air-speed indicators – Mach meters – Pitot static systems – Altitude and air-speed warnings – air-data computers – Advanced sensors. Magnetic Compass - Gyroscope principles – Practical gyroscopes, Artificial horizon, Directional Gyroscopes, Rate gyroscopes – Turn and Slip Indicators – Turn coordinators         |                                                                                                                 |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>FLIGHT INSTRUMENTS</b>                                                                                       | <b>9 Periods</b> |  |
| Study of various types of engine instruments – Engine Speed Measurement sensors – Torque sensors – Engine fuel Indicators - Pressure measurement sensors                                                                                                                                                                                                                           |                                                                                                                 |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                 |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                               |                                                                                                                 |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------|
| 1 | David Wyatt, “Aircraft Flight Instruments and Guidance Systems”, Routledge, 1 <sup>st</sup> Edition, 2015.            |
| 2 | Pallet, E.H.J, "Aircraft Instruments, Principles and Applications", Pearson Education, 2 <sup>nd</sup> Edition, 2009. |

**REFERENCES:**

|   |                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------------------------------------|
| 1 | S. Nagabhushana, “Aircraft Instrumentation and systems”, I.K International Publishing limited, 1 <sup>st</sup> Edition, 2010.           |
| 2 | Mekinley, J.L. and R.D. Bent, “Aircraft Power Plants”, McGraw Hill, 10 <sup>th</sup> Edition, 2022.                                     |
| 3 | Chris Binns, “Aircraft Systems, Instruments, Communications, Navigation and Control”, John Wiley & Sons, 1 <sup>st</sup> Edition, 2019. |
| 4 | David A Lombardo, “Aircraft Systems”, McGraw-Hill Education, 2 <sup>nd</sup> Edition, 1999.                                             |

| <b>COURSE OUTCOMES</b>                                      |                                                                  | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                  |                                |
| CO1                                                         | Describe the principle and working of different aircraft systems | K2                             |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                                                          |    |
|-----|------------------------------------------------------------------------------------------|----|
| CO2 | Analyze the performance of various aircraft engine systems.                              | K2 |
| CO3 | Compare the features of various flight control systems                                   | K2 |
| CO4 | Explain the principles and working of air data and Gyroscopic instruments.               | K2 |
| CO5 | Elucidate the operation of sensors involved in measurement of various engine parameters. | K2 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                             |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-----------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                         | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                           | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| CO2                                                 | 3                                                                           | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| CO3                                                 | 3                                                                           | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| CO4                                                 | 3                                                                           | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| CO5                                                 | 3                                                                           | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| <b>22NPE\$12</b>                                    | 3                                                                           | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                             |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 30                | 70                   |                |                |                   |                 | 100     |
| CAT2                                                         | 30                | 70                   |                |                |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                | 70                   |                |                |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                | 70                   |                |                |                   |                 | 100     |
| ESE                                                          | 30                | 70                   |                |                |                   |                 | 100     |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                   |
|-----------------|-----------------------------------|
| <b>22NPES13</b> | <b>AUTOMOTIVE INSTRUMENTATION</b> |
|-----------------|-----------------------------------|

| <b>PREREQUISITES</b>                      | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|-------------------------------------------|-----------------|----------|----------|----------|----------|
| <b>22NPC303 - Sensors and Transducers</b> | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                             |                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                               | To illustrate the injection methods,application of sensors and actuators, communications and advanced technologies used in automotive field |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS</b>                                                                                               | <b>9 Periods</b> |
| Evolution of electronics in automobiles, Emission laws, Euro standards, Equivalent Bharat standards, Charging systems: working and design of charging circuit, alternators, requirements of starting system, starter motors and starter circuits - Introduction to Battery Management Systems.                                                                                                                                                                        |                                                                                                                                             |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>IGNITION AND INJECTION SYSTEMS</b>                                                                                                       | <b>9 Periods</b> |
| Ignition systems: Ignition fundamentals, Electronic Ignition system, Programmed Ignition, Distribution less Ignition, Direct Ignition, Spark Plugs, Electronic fuel control, basics of combustion, engine fuelling and exhaust emission, electronic control of Carburetion, petrol fuel injection, diesel fuel injection.                                                                                                                                             |                                                                                                                                             |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>SENSORS AND ACTUATORS</b>                                                                                                                | <b>9 Periods</b> |
| Working principle and characteristics of airflow rate, engine crankshaft angular position, hall effect, throttle angle, temperature, exhaust gas oxygen sensors. Fuel injector, exhaust gas recirculation actuators, stepper motor actuator and vacuum operated actuator                                                                                                                                                                                              |                                                                                                                                             |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>ENGINE CONTROL SYSTEM AND COMMUNICATION</b>                                                                                              | <b>9 Periods</b> |
| Control modes for fuel control, engine control subsystems, ignition control methodologies, different ECUs used in engine management. In vehicle networks: CAN standard. Diagnostic systems in modern automobiles.5G Advanced Driver Assistance Systems (ADAS), Augmented Road Sign information, In-vehicle Infotainment and Telematics, Automotive Maintenance System, Truck's performance statistics like fuel and mileage, Tracking traffic conditions on the road. |                                                                                                                                             |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>CHASSIS AND SAFETY SYSTEMS</b>                                                                                                           | <b>9 Periods</b> |
| Traction control system, Cruise control system, electronic control of Automatic Transmission, Antilock Braking system(ABS), Electronic Suspension system, working of Airbag, Centralized Door Locking system, Climate Control of cars.                                                                                                                                                                                                                                |                                                                                                                                             |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                             |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                             |                  |

## TEXT BOOKS:

|   |                                                                                                                      |
|---|----------------------------------------------------------------------------------------------------------------------|
| 1 | Tom Denton, " <i>Automotive Electrical and Electronics Systems</i> ",3 <sup>rd</sup> Edition, SAE International,2014 |
| 2 | Robert Bosch " <i>Automotive Electric and Automotive Electronics</i> "5 <sup>th</sup> Edition, springer, 2014.       |

## REFERENCES:

|   |                                                                                                                                                                          |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Barry Holemeak, " <i>Automotive Electrical and Electronics</i> " ,4 <sup>th</sup> edition Delmar Publishers, 2010                                                        |
| 2 | William Ribbens, " <i>Understanding Automotive Electronics □ An Engineering Perspective</i> ", 7 <sup>th</sup> Edition, Elsevier Butterworth□Heinemann Publishers, 2012. |
| 3 | James D Halderman, " <i>Automotive Electrical and Electronics</i> " ,5 <sup>th</sup> edition, Prentice Hall, 2013                                                        |
| 4 | V A W Hillier " <i>Fundamentals of Automotive Electronics</i> " ,2 <sup>nd</sup> Edition , oxford, 2011                                                                  |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

## COURSE OUTCOMES

Upon Completion of the course, the students will be able to

## Bloom's Taxonomy Mapped

|     |                                                                                                       |    |
|-----|-------------------------------------------------------------------------------------------------------|----|
| CO1 | Explain the knowledge of the basic electrical and electronic components used in an automotive systems | K2 |
| CO2 | Describe the methods of fuelling systems in automobiles.                                              | K2 |
| CO3 | Choose appropriate sensors and actuators for automobiles based on applications                        | K3 |
| CO4 | Select the Control schemes for Engine Management systems.                                             | K3 |
| CO5 | Apply instrumentation techniques to safety in modern automobile                                       | K3 |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping                             |                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------|-------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                      | PO1                                 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                          | 1                                   | -   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| CO2                                          | 1                                   | -   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| CO3                                          | 1                                   | -   | -   | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| CO4                                          | 1                                   | -   | 2   | -   | -   | 1   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| CO5                                          | 1                                   | -   | 2   | -   | -   | 2   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| 22NPE\$13                                    | 1                                   | -   | 1   | -   | -   | 1   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| b) CO and Key Performance Indicators mapping |                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                          | 1.1.1,1.1.2,1.2.1                   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                          | 1.1.1,1.1.2,1.2.1                   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                          | 1.1.1,1.1.2,1.2.1                   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                          | 1.1.1,1.1.2,1.2.1,3.1.1.3.1.2,6.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                          | 1.1.1,1.1.2,1.2.1,3.1.1.3.1.2,6.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 30                | 40                   | 30             |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 50                   | 30             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 50             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 50             |                 |                   |                 | 100     |
| ESE                                                          | 30                | 50                   | 20             |                 |                   |                 | 100     |

|                  |                                    |
|------------------|------------------------------------|
| <b>22NPE\$14</b> | <b>SAFETY INSTRUMENTED SYSTEMS</b> |
|------------------|------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                              |                  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | To introduce students to the basic concepts, standards and risk analysis techniques to design a safety instrumented systems. |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>INTRODUCTION</b>                                                                                                          | <b>9 Periods</b> |
| Safety Instrumented System (SIS): need, features, components, difference between basic process control system and SIS. Risk: Risk measurement, risk tolerance, Safety integrity level, safety instrumented functions Standards and Regulation: HSE-PES, AICHE-CCPS, IEC-61508, ANSI/ISA-84.00.01-2004 (IEC 61511 Mod) & ANSI/ISA – 84.01-1996, NFPA 85, API RP 556, API RP 14C, OSHA (29 CFR 1910.119 – Process Safety Management of Highly Hazardous Chemicals – SIS design cycle                           |                                                                                                                              |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS</b>                                                               | <b>9 Periods</b> |
| Prevention Layers: Process Plant Design, Process Control System, Alarm Systems and procedures, Shutdown/Interlock/Instrumented Systems (Safety Instrumented Systems – SIS), Physical Protection - Mitigation Layers: Containment Systems, Scrubbers and Flares, Fire and Gas (F&G) Systems, Evacuation Procedures - Safety specification requirements as per standards, causes for deviation from the standards.                                                                                             |                                                                                                                              |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | <b>SAFETY INTEGRITY LEVEL (SIL)</b>                                                                                          | <b>9 Periods</b> |
| Evaluating Risk, Safety Integrity Levels - SIL Determination Method : As Low As Reasonably Practical ( ALARP ), Risk matrix, Risk Graph, Layers Of Protection Analysis ( LOPA ) – Issues related to system size and complexity –Issues related to field device safety – Functional Testing.                                                                                                                                                                                                                  |                                                                                                                              |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>SYSTEM EVALUATION</b>                                                                                                     | <b>9 Periods</b> |
| Failure Modes, Safe/Dangerous Failures, Detected/Undetected Failures, Metrics: Failure Rate, MTBF, and Life, Degree of Modelling Accuracy, Modelling Methods: Reliability Block Diagrams, Fault Trees, Markov Models - Consequence analysis: Characterization of potential events, dispersion, impacts, occupancy considerations, consequence analysis tools - Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities. |                                                                                                                              |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>CASE STUDY</b>                                                                                                            | <b>9 Periods</b> |
| SIS Design check list - Case Description: Furnace/Fired Heater Safety Shutdown System: Scope of Analysis, Define Target SILs, Develop Safety Requirement Specification (SRS), SIS Conceptual Design, Life Cycle Cost Analysis, Verify that the Conceptual Design Meets the SIL, Detailed Design, Installation, Commissioning and Pre-start up Tests, Operation and Maintenance Procedures.                                                                                                                   |                                                                                                                              |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                              |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                              |                  |

**TEXT BOOKS:**

|   |                                                                                                                                                             |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Paul Gruhn and Harry L. Cheddie " Safety Instrumented systems: Design, Analysis and Justification" ISA, 2<sup>nd</sup> Edition, 2006.</i>                |
| 2 | <i>Eric W. Scharpf, Heidi J. Hartmann, Harlod W. Thomas "Practical SIL target selection: Risk analysis per the IEC 61511 safety Lifecycle" Exida, 2012.</i> |

**REFERENCES:**

|   |                                                                                                                                                                                                                 |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>William M. Goble and Harry Cheddie "Safety Instrumented Systems Verification: Practical Probabilistic Calculations" ISA, 2005.</i>                                                                           |
| 2 | <i>Edward Marszal, Eric W. Scharpf "Safety Integrity Level Selection: Systematic Methods Including Layer of Protection Analysis" ISA, 2002.</i>                                                                 |
| 3 | <i>Kevin J. Mitchell, Peter Hereña, Todd M. Longendelpher, Matthew C. Kuhn, "Safety Instrumented Systems Engineering Handbook", Kenexis Consulting Corporation – Columbus, OH, 1<sup>st</sup> Edition, 2010</i> |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|   |                                                                                                                 |
|---|-----------------------------------------------------------------------------------------------------------------|
| 4 | Bela. G. LIPTAK "Instrumentation in Processing Industries" Chilton Book Company, 1 <sup>st</sup> Edition, 2012. |
|---|-----------------------------------------------------------------------------------------------------------------|

| COURSE OUTCOMES                                             |                                                                                                                     | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                                                                     |                         |
| CO1                                                         | Comprehend the role of safety instrumented system in the industry                                                   | K2                      |
| CO2                                                         | Demonstrate the understanding of various protection layers and safety specifications followed in the industry.      | K2                      |
| CO3                                                         | Compute safety integrity level for a given condition                                                                | K3                      |
| CO4                                                         | Quantitatively evaluate and model safety systems                                                                    | K3                      |
| CO5                                                         | Interpret the results and draw meaningful conclusions through proper documentation for a safety instrumented system | K2                      |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping                             |                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                      | PO1                                                                                                                      | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                          | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO2                                          | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO3                                          | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO4                                          | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO5                                          | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| 22NPE\$14                                    | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| b) CO and Key Performance Indicators mapping |                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 10             | 40              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 10             | 40              |                   |                 | 100     |
| ESE                                                          | 10                | 90                   |                |                 |                   |                 | 100     |

|                 |                                           |
|-----------------|-------------------------------------------|
| <b>22NPES15</b> | <b>SMART AND WIRELESS INSTRUMENTATION</b> |
|-----------------|-------------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                             |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                 | To provide adequate knowledge on smart instrumentation and wireless sensor networks and to impart knowledge on various standard protocols used in wireless instrumentation. |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                         | <b>SENSORS</b>                                                                                                                                                              | <b>9 Periods</b> |
| Sensor classification-thermal sensors-humidity sensors-capacitive sensors-planar inter digital sensors-planar electromagnetic sensors-light sensing technology-moisture sensing technology-carbon dioxide (co2) sensing technology-sensors parameters.                                                                                                                  |                                                                                                                                                                             |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                        | <b>INTERFACING OF SENSORS AND SIGNAL CONDITIONING</b>                                                                                                                       | <b>9 Periods</b> |
| Introduction-Change of Bias and Level of Signals -Loading Effect on Sensor's Output - Potential Divider -Low Pass RC Filter-High Pass RC Filter - Practical Issues of Designing Passive Filters - Op-Amp Based Instrumentation - Current-to-Voltage Converter - Comparator - Factors Affecting Performance of Sensors - Effect of Temperature - Degradation of Sensors. |                                                                                                                                                                             |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                       | <b>WIRELESS SENSOR NETWORK</b>                                                                                                                                              | <b>9 Periods</b> |
| Frequency of Wireless communication-Development of Wireless Sensor Network based Project-Wireless sensor based on microcontroller and communication device-Zigbee Communication device.                                                                                                                                                                                 |                                                                                                                                                                             |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                        | <b>WIRELESS COMMUNICATION</b>                                                                                                                                               | <b>9 Periods</b> |
| Tedes IEEE 1412- Brief description of API mode data transmission-Testing the communication between coordinator and remote XBee- Design and development of graphical user interface for receiving sensor data using C++. A brief review of signal processing techniques for structural health monitoring.                                                                |                                                                                                                                                                             |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                         | <b>WIRELESS SENSOR NETWORK APPLICATIONS</b>                                                                                                                                 | <b>9 Periods</b> |
| WSN based physiological parameters monitoring system- Intelligent sensing system for emotion recognition-WSN based smart power monitoring system. Digital light processor (DLP).                                                                                                                                                                                        |                                                                                                                                                                             |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                             |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                    |                                                                                                                                                                             |                  |

**TEXT BOOKS:**

|   |                                                                                                                                        |
|---|----------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Subhas Chandra Mukhopadhyay, " <i>Smart Sensors, Measurement and Instrumentation</i> ", Springer Heidelberg, 2013.                     |
| 2 | Halit Eren, " <i>Wireless Sensors and Instruments: Networks, Design and Applications</i> ", CRC Press, Taylor and Francis Group, 2006. |

**REFERENCES:**

|   |                                                                                                                                                         |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Uvais Qidwai, " <i>Smart Instrumentation: A data flow approach to Interfacing</i> ", Chapman & Hall, 1 <sup>st</sup> Edition, 2013.                     |
| 2 | Waltenegus Dargie, Christian Poellabauer, " <i>Fundamentals of wireless sensor networks : theory and practice</i> ", A John Wiley and Sons, Ltd., 2009. |

| <b>COURSE OUTCOMES</b>                                      |                                                                                           | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                           |                                |
| CO1                                                         | Explain Smart and Wireless Instrumentation with respect to various performance parameters | K2                             |
| CO2                                                         | Describe the interfacing of sensors and signal conditioning                               | K2                             |
| CO3                                                         | Discuss the functioning of WSN (Wireless sensor Network)                                  | K2                             |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                             |    |
|-----|-------------------------------------------------------------|----|
| CO4 | Describe the fundamentals of wireless digital communication | K2 |
| CO5 | Design and develop applications using WSN.                  | K3 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                      | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 2    | 2    |
| CO2                                                 | 3                                                                      | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | 2    |
| CO3                                                 | 3                                                                      | 1   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | —    | 2    |
| CO4                                                 | 3                                                                      | 2   | 2   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | 2    |
| CO5                                                 | 3                                                                      | 1   | 2   | 3   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | 2    |
| <b>22NPES15</b>                                     | 3                                                                      | 2   | 2   | 2   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | 2    | 2    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.2.,2, 2.1.1,2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4.  |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.2.,2, 2.1.1,2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4.  |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.2.,2, 2.1.1,2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4.  |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.1.2, 1.2.1, 1.2.,2, 2.1.1,2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4,  |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.1.2, 1.2.1, 1.2.,2, 2.1.1,2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4., |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 80                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 60                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 60                   | 20             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 60                   | 20             |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

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|-----------------|--------------------------|
| <b>22NPES16</b> | <b>ELECTRIC VEHICLES</b> |
|-----------------|--------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                         |                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To enhance student proficiency in electric vehicles, energy sources and hybrid vehicle principles for professional competence in the automotive sector. |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>INTRODUCTION TO ELECTRIC VEHICLES</b>                                                                                                                | <b>9 Periods</b> |
| Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refuelling Systems – EV classification and Scenario in India. |                                                                                                                                                         |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>ELECTRIC TRAINS</b>                                                                                                                                  | <b>9 Periods</b> |
| Electric drive-trains: Concept of electric traction, Various electric drive train topologies, power flow control in electric drive-train topologies. Electric propulsion unit: Electric components used in hybrid and electric vehicles - Configuration and control of DC Motor drives - Induction Motor drives - Permanent Magnet Motor drives - Switched Reluctance Motor drives - drive system efficiency.                                                             |                                                                                                                                                         |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>ANALYSIS OF ENERGY STORAGE</b>                                                                                                                       | <b>9 Periods</b> |
| Energy storage: – Lead Acid- Nickel Metal Hydride – Lithium-ion Sodium based- Fuel Cell, Super Capacitor and Flywheel based energy storage and its analysis. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE) - Sizing the propulsion motor and power electronics - Selecting the energy storage technology - Communications - Supporting subsystems.                                                                      |                                                                                                                                                         |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>ENERGY MANAGEMENT STRATEGIES</b>                                                                                                                     | <b>9 Periods</b> |
| Energy management strategies used in hybrid and electric vehicles: classification - Rule-based - Optimization-based - Learning-based - Deep reinforced learning. Comparison of different energy management strategies - Implementation issues.                                                                                                                                                                                                                            |                                                                                                                                                         |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>BUSINESS PERSPECTIVE OF ELECTRIC VEHICLE</b>                                                                                                         | <b>9 Periods</b> |
| Design of a Hybrid Electric Vehicle (HEV) and Battery Electric Vehicle (BEV) - Fuel cell Heavy Duty Vehicles. Business: E-mobility business, electrification challenges, Connected mobility and Autonomous mobility - EVs in infrastructure system - Integration of EVs in smart grid - Social dimensions of EVs.                                                                                                                                                         |                                                                                                                                                         |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                         |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                         |                  |

**TEXT BOOKS:**

|   |                                                                                                                                                                          |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>MehrdadEhsani, YiminGao, Sebatien Gay and Ali Emadi, “Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design”, CRC press, 2016.</i> |
| 2 | <i>C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley &amp; Sons, 2018.</i>              |

**REFERENCES:**

|   |                                                                                                                      |
|---|----------------------------------------------------------------------------------------------------------------------|
| 1 | <i>S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.</i> |
| 2 | <i>James Larminie and John Lory, “Electric Vehicle Technology – Explained”, John Wiley &amp; Sons Ltd, 2016.</i>     |
| 3 | <i>Sandeep Dhameja, “Electric Vehicle Battery Systems”, Butterworth – Heinemann, 2018.</i>                           |
| 4 | <i>T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.</i>                                                   |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                                                                    | <b>Bloom's Taxonomy Mapped</b> |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| CO1                                                                                   | Classify hybrid and electric vehicles to understand their social and environmental impact.                                         | K2                             |
| CO2                                                                                   | Analyze electric drive-train topologies for efficient power distribution.                                                          | K3                             |
| CO3                                                                                   | Evaluate energy storage options for effective system integration.                                                                  | K2                             |
| CO4                                                                                   | Apply energy management strategies to optimize vehicle performance.                                                                | K3                             |
| CO5                                                                                   | Describe business perspectives to outline strategies for integrating electric vehicles into infrastructure and smart grid systems. | K2                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                               |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                             | PO1                                                                                                                           | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 3                                                                                                                             | 2        | 2        | 1        | -        | -        | 2        | -        | -        | -        | -        | -        | 1        | 1        | 2        |
| CO2                                                 | 3                                                                                                                             | 2        | 1        | -        | -        | -        | 2        | -        | -        | -        | -        | -        | 1        | 1        | 2        |
| CO3                                                 | 3                                                                                                                             | 2        | 2        | 1        | -        | -        | 2        | -        | -        | -        | -        | -        | 1        | 1        | 2        |
| CO4                                                 | 3                                                                                                                             | 2        | 2        | 1        | -        | -        | 2        | -        | -        | -        | -        | -        | 1        | 1        | 2        |
| CO5                                                 | 3                                                                                                                             | 2        | 2        | 1        | -        | -        | 2        | -        | -        | -        | -        | -        | 1        | 1        | 2        |
| <b>22NPE\$16</b>                                    | <b>3</b>                                                                                                                      | <b>2</b> | <b>2</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>2</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>1</b> | <b>2</b> |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                               |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.4.4,3.1.1,3.1.3,3.1.4,3.1.5,3.1.6,4.1.1,7.1.2,7.2.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,3.1.1,3.1.4,3.1.5,7.1.2,7.2.2                                           |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.4.4,3.1.1,3.1.3,3.1.4,3.1.5,3.1.6,4.1.1,7.1.2,7.2.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.4.4,3.1.1,3.1.3,3.1.4,3.1.5,3.1.6,4.1.1,7.1.2,7.2.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.4.4,3.1.1,3.1.3,3.1.4,3.1.5,3.1.6,4.1.1,7.1.2,7.2.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 80                   |                |                |                   |                 | 100     |
| CAT2                                                         | 20                | 80                   |                |                |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 60                   | 20             |                |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 60                   | 20             |                |                   |                 | 100     |
| ESE                                                          | 30                | 70                   |                |                |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|          |                            |
|----------|----------------------------|
| 22NPES17 | BIOMEDICAL INSTRUMENTATION |
|----------|----------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                |                                                                                                                                              |                                                    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                        | To provide an overview about the human physiological system, instrumentation system for measuring and analyzing the physiological parameters |                                                    |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                | <b>PHYSIOLOGY</b>                                                                                                                            | <b>9 Periods</b>                                   |
| Cell and its structure – Resting and action potential – Physiology of circulatory system, Respiratory system, Nervous system –Bio-potential electrodes – Types of electrode - Electrode behavior and circuit models- Transducers for biomedical applications.. |                                                                                                                                              |                                                    |
| <b>UNIT - II</b>                                                                                                                                                                                                                                               | <b>ELECTRO PHYSIOLOGICAL MEASUREMENT AND SAFETY</b>                                                                                          | <b>9 Periods</b>                                   |
| Classification of biological signals: ECG, EEG, EMG, ERG, EOG – Lead system and recording methods –Typical waveforms - Electrical safety in medical environment, Shock hazards – Leakage current-Instruments to protect against electrical hazards             |                                                                                                                                              |                                                    |
| <b>UNIT - III</b>                                                                                                                                                                                                                                              | <b>NON- ELECTRICAL PARAMETER MEASUREMENTS AND TELEMETRY</b>                                                                                  | <b>9 Periods</b>                                   |
| Measurement of Blood pressure, Blood flow, Cardiac output – Plethysmography – Measurement of heart sounds – Blood gas analysers – Oximeters -Biotelemetry                                                                                                      |                                                                                                                                              |                                                    |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                               | <b>MEDICAL IMAGING SYSTEMS</b>                                                                                                               | <b>9 Periods</b>                                   |
| X-ray Machine – Computer Radiography - Computed Tomography – Magnetic Resonance Imaging – Ultrasonic Imaging Systems – Positron Emission Tomography –Single Photon Emission Computer Tomography – Thermography – Endoscopy.                                    |                                                                                                                                              |                                                    |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                | <b>ASSISTING AND THERAPEUTIC DEVICE</b>                                                                                                      | <b>9 Periods</b>                                   |
| Pacemakers – Defibrillators – Ventilator – Nerve and muscle stimulator – Heart lung machine – Kidney machine – Audiometers – Diathermy — Application of Lasers in biomedicine.                                                                                 |                                                                                                                                              |                                                    |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                             |                                                                                                                                              |                                                    |
| <b>Lecture: 45 Periods</b>                                                                                                                                                                                                                                     | <b>Tutorial: 0 Periods</b>                                                                                                                   | <b>Practical: 0 Periods      Total: 45 Periods</b> |

**TEXT BOOKS:**

|   |                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------|
| 1 | Leslie Cromwell, " <i>Biomedical Instrumentation and measurement</i> ", Prentice hall, 2 <sup>nd</sup> Edition, 2015. |
| 2 | Khandpur. R.S " <i>Handbook of Biomedical Instrumentation</i> ", McGraw Hill, 3 <sup>rd</sup> edition, 2014.          |

**REFERENCES:**

|   |                                                                                                                                                  |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | John G. Webster, " <i>Medical Instrumentation Application and Design</i> ", Wiley India , 4 <sup>th</sup> edition, 2015.                         |
| 2 | Joseph J. Carr and John M. Brown, " <i>Introduction to Biomedical Equipment Technology</i> ", Pearson publishing, 4 <sup>th</sup> Edition, 2013. |
| 3 | James E. Moore Jr, Duncan J. Maitland, " <i>Biomedical Technology and Devices</i> ", CRC press, 2 <sup>nd</sup> Edition 2013                     |
| 4 | Andrew G. Webb, " <i>Principles of Biomedical Instrumentation</i> ", Cambridge University Press, 1 <sup>st</sup> Edition, 2018.                  |

| COURSE OUTCOMES                                             |                                                                                                              | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                                                              |                         |
| CO1                                                         | Explain the physical foundations of biological systems and the various electrodes used in the medical field. | K2                      |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                                                                              |    |
|-----|--------------------------------------------------------------------------------------------------------------|----|
| CO2 | Discuss about the various electro physiological measurements in the human body and electrical safety.        | K2 |
| CO3 | Apply the appropriate medical instrument for the measurement of non-electrical parameters of the human body. | K2 |
| CO4 | Compare the various medical imaging techniques and their applications.                                       | K2 |
| CO5 | Describe the working of medical assisting and therapy equipment.                                             | K2 |

**COURSE ARTICULATION MATRIX**

| a) CO/PO Mapping                             |                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------|---------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                      | PO1                                                           | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                          | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| CO2                                          | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| CO3                                          | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| CO4                                          | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| CO5                                          | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| 22NPES17                                     | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    | 2    |
| b) CO and Key Performance Indicators mapping |                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 80                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 80                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 80                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 80                   |                |                 |                   |                 | 100     |
| ESE                                                          | 20                | 80                   |                |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|           |                       |
|-----------|-----------------------|
| 22NPE\$18 | BIO SIGNAL PROCESSING |
|-----------|-----------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                         |                                                                                                    |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                 | To impart knowledge on biosignals and filtering techniques for feature extraction from biosignals. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                         | <b>BIOSIGNAL AND SPECTRAL CHARACTERISTICS</b>                                                      | <b>9 Periods</b> |  |
| Introduction to Biosignals: Nature of Biomedical Signals - ENG, EMG, ECG, EEG, ERP and PCG - Noise: Random, Structured and Physiological Noise – Filters: IIR, FIR and Integer Filters for ECG Analysis.                                                                                |                                                                                                    |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                        | <b>SPECTRAL ESTIMATION OF BIO SIGNALS</b>                                                          | <b>9 Periods</b> |  |
| Time Series Analysis - Application in EEG, PCG Signals - Time Varying Analysis of Heart-Rate Variability - Model based ECG Simulator - Spectral Estimation: Blackman Tukey Method, Periodogram and Model based Estimation - Application in Heart Rate Variability - PCG Signals.        |                                                                                                    |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                       | <b>ADAPTIVE FILTERING AND WAVELET DETECTION</b>                                                    | <b>9 Periods</b> |  |
| Adaptive Filtering: Noise canceller, LMS Adaptive Filter, RLS Adaptive Filter - Removal of Artifacts in ECG - Wavelet Detection in ECG: Structural Features, Matched Filtering, Adaptive Wavelet Detection - Detection of Overlapping Wavelets.                                         |                                                                                                    |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                        | <b>BIOSIGNAL CLASSIFICATION AND RECOGNITION</b>                                                    | <b>9 Periods</b> |  |
| Signal Classification and Recognition – Statistical Signal Classification - Linear Discriminant Function - Direct Feature Selection and Ordering - Back Propagation Neural Network based Classification - Application in Normal versus Ectopic ECG Beats.                               |                                                                                                    |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                         | <b>TIME FREQUENCY AND MULTIVARIATE ANALYSIS</b>                                                    | <b>9 Periods</b> |  |
| Time Frequency Representation: Spectrogram, Wigner Distribution - Time-scale Representation: Scalogram, Wavelet Analysis – Data Reduction Techniques: ECG Data Compression, ECG Characterization - Feature Extraction - Wavelet Packets - Multivariate Component Analysis: PCA and ICA. |                                                                                                    |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                      |                                                                                                    |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                    |                                                                                                    |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                      |
|---|--------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Rangaraj M. Rangayyan, “ <i>Biomedical Signal Analysis-A Case Study Approach</i> ”, Wiley IEEE Press, 2 <sup>nd</sup> Edition, 2016. |
| 2 | Willis J. Tompkins, “ <i>Biomedical Digital Signal Processing</i> ”, Prentice Hall of India, 1 <sup>st</sup> Edition, 2003.          |

**REFERENCES:**

|   |                                                                                                                                                      |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Emmanuel C. Ifeakor, Barrie W.Jervis, “ <i>Digital Signal processing - A Practical Approach</i> ”, Pearson Education Ltd., 2004.                     |
| 2 | Raghuveer M. Rao and Ajith S.Bopardikar, “ <i>Wavelet Transform – Introduction to Theory and its Applications</i> ”, Pearson Education, India, 2000. |
| 3 | K.P.Soman and K.Ramachandran, “ <i>Insight into Wavelet from Theory to Practice</i> ”, PHI, 3 <sup>rd</sup> Edition, 2010.                           |
| 4 | Arnon Cohen, “ <i>Bio-Medical Signal Processing Vol I and Vol II</i> ”, CRC Press Inc., Florida, 1999.                                               |

| COURSE OUTCOMES                                             |                                                              | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|--------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                              |                         |
| CO1                                                         | Explain the characteristics of biosignals                    | K2                      |
| CO2                                                         | Describe biosignals in time domain and estimate the spectrum | K2                      |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b>                                      |                                                             | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                             |                                |
| CO1                                                         | Explain the characteristics of biosignals                   | K2                             |
| CO3                                                         | Apply wavelet detection techniques for biosignal processing | K3                             |
| CO4                                                         | Classify biosignals using neural networks                   | K3                             |
| CO5                                                         | Analyze the features using multivariate component analysis  | K4                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                                 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|-----|-----|-----|-----|-----|------|------|------|----------|----------|------|
| COs/POs                                             | PO1                                                                                                                                                             | PO2      | PO3      | PO4      | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1     | PSO2     | PSO3 |
| CO1                                                 | 3                                                                                                                                                               | 3        | 1        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | 1        | -    |
| CO2                                                 | 3                                                                                                                                                               | 3        | 1        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | 1        | -    |
| CO3                                                 | 3                                                                                                                                                               | 3        | 1        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | 1        | -    |
| CO4                                                 | 3                                                                                                                                                               | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | 1        | -    |
| CO5                                                 | 3                                                                                                                                                               | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | 1        | -    |
| <b>22NPE\$18</b>                                    | <b>3</b>                                                                                                                                                        | <b>3</b> | <b>1</b> | <b>2</b> | -   | -   | -   | -   | -   | -    | -    | -    | <b>2</b> | <b>1</b> | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                                 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2                      |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2                      |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2                      |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO4                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4, 4.2.1, 4.3.3 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO5                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4, 4.2.1, 4.3.3 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                | 40                   | 40             |                |                   |                 | 100     |
| CAT2                                                         |                   | 40                   | 40             | 20             |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 50             |                |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   |                      | 60             | 40             |                   |                 | 100     |
| ESE                                                          | 20                | 50                   | 30             |                |                   |                 | 100     |

|                 |                                               |
|-----------------|-----------------------------------------------|
| <b>22NPES19</b> | <b>PRINCIPLES OF DIGITAL IMAGE PROCESSING</b> |
|-----------------|-----------------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                 |                                                                                                                            |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                         | To provide knowledge on digital image fundamentals and various image processing techniques in spatial and frequency domain |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                 | <b>DIGITAL IMAGE FUNDAMENTALS</b>                                                                                          | <b>9 Periods</b> |  |
| Fundamental steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationship between pixels - Color image fundamentals - Color models - Two-dimensional mathematical preliminaries - 2D transforms: DFT and DCT. |                                                                                                                            |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                | <b>IMAGE ENHANCEMENT</b>                                                                                                   | <b>9 Periods</b> |  |
| Spatial Domain: Intensity transforms – Histogram processing – Smoothing and Sharpening Spatial Filtering. Frequency Domain: Smoothing and Sharpening frequency domain filters – Ideal, Butterworth, Gaussian and Laplacian filters - Homomorphic filtering - Overview of Color image enhancement.               |                                                                                                                            |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                               | <b>IMAGE RESTORATION</b>                                                                                                   | <b>9 Periods</b> |  |
| Image Restoration - Degradation model - Noise models: Properties, Probability Density Function - Noise reduction using spatial and frequency domain filters - Mean Filters, Order Statistics, Adaptive filters, Band reject filters, Band pass filters – Notch Filters – Inverse Filtering – Wiener filtering.  |                                                                                                                            |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                | <b>IMAGE SEGMENTATION</b>                                                                                                  | <b>9 Periods</b> |  |
| Image detection: Point, line and edge detection - Thresholding: Global and multiple thresholding - Region based segmentation: Region growing, Region splitting and Region merging – Segmentation using watersheds - Morphological processing - Erosion and dilation.                                            |                                                                                                                            |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                 | <b>IMAGE COMPRESSION</b>                                                                                                   | <b>9 Periods</b> |  |
| Need for data compression - Coding redundancy – Fidelity criteria – Compression methods: Huffman, Run Length Encoding and Arithmetic coding - Coding Standards : JPEG and MPEG.                                                                                                                                 |                                                                                                                            |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                              |                                                                                                                            |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                            |                                                                                                                            |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Rafael C. Gonzalez, Richard E. Woods, " <b>Digital Image Processing</b> ", Pearson Education India Ltd., 4 <sup>th</sup> Edition, 2018. |
| 2 | Anil K. Jain, " <b>Fundamentals of Digital Image Processing</b> ", Pearson Education India Ltd., 1 <sup>st</sup> Edition, 2015.         |

**REFERENCES:**

|   |                                                                                                                                    |
|---|------------------------------------------------------------------------------------------------------------------------------------|
| 1 | William K. Pratt, " <b>Digital Image Processing</b> ", Apple Academic Press Inc., 1 <sup>st</sup> Edition, 2013.                   |
| 2 | Sridhar S., " <b>Digital Image Processing</b> ", Oxford University Press, 3 <sup>rd</sup> Edition, 2016.                           |
| 3 | Abishak Yadav and Poonam Yadav, " <b>Digital Image Processing</b> ", Laxmi Publications, Pvt. Ltd., 2 <sup>nd</sup> Edition, 2016. |
| 4 | Kenneth R. Castleman, " <b>Digital Image Processing</b> ", Pearson Education USA, 1 <sup>st</sup> Edition, 2007.                   |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Explain the concept of digital image processing and image transform techniques | K2                                     |
| CO2                                                                                   | Enhance images using spatial and frequency domain filters                      | K3                                     |
| CO3                                                                                   | Implement different types of filters for image noise reduction                 | K3                                     |
| CO4                                                                                   | Analyze image segmentation techniques for morphological operations             | K4                                     |
| CO5                                                                                   | Describe the concepts of image compression techniques                          | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                                 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|-----|-----|-----|-----|-----|------|------|------|----------|----------|------|
| COs/POs                                             | PO1                                                                                                                                                             | PO2      | PO3      | PO4      | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1     | PSO2     | PSO3 |
| CO1                                                 | 3                                                                                                                                                               | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | 1        | -    |
| CO2                                                 | 3                                                                                                                                                               | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | 1        | -    |
| CO3                                                 | 3                                                                                                                                                               | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | 1        | -    |
| CO4                                                 | 3                                                                                                                                                               | 3        | 1        | 3        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | 1        | -    |
| CO5                                                 | 3                                                                                                                                                               | 3        | 1        | 3        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | 1        | -    |
| <b>22NPE\$19</b>                                    | <b>3</b>                                                                                                                                                        | <b>3</b> | <b>1</b> | <b>3</b> | -   | -   | -   | -   | -   | -    | -    | -    | <b>2</b> | <b>1</b> | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                                 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4               |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4               |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4               |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO4                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4, 4.2.1, 4.3.3 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO5                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4, 4.2.1, 4.3.3 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                | 40                   | 40             |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 30                   | 30             | 20              |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 40                   | 40             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 40                   | 40             | 20              |                   |                 | 100     |
| ESE                                                          | 20                | 30                   | 30             | 20              |                   |                 | 100     |

|                 |                        |
|-----------------|------------------------|
| <b>22NPES20</b> | <b>MEDICAL IMAGING</b> |
|-----------------|------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                    |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | To impart knowledge on different types of medical imaging equipments and their significance in medical diagnostics |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>MEDICAL X-RAY EQUIPMENT</b>                                                                                     | <b>9 Periods</b> |  |
| Nature of X-rays: X-Ray Absorption, Tissue Contrast - X-Ray Equipment: X-ray Tube, Collimator, Bucky Grid, Power Supply - Digital Radiography - Discrete Digital Detectors: Storage, Phosphor and Film Scanning Types – Fluoroscopy: X-Ray Image Intensifier Tubes and Digital Fluoroscopy – Angiography: Cine Angiography, Digital Subtraction Angiography - Mammography.                                                                                                                                                |                                                                                                                    |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>COMPUTED TOMOGRAPHY</b>                                                                                         | <b>9 Periods</b> |  |
| Principles of Tomography - CT Generations - X-Ray: Source, Collimation and Detector - Viewing Systems: Spiral CT Scanning, Ultra Fast CT Scanners - Image Reconstruction Techniques: Back Projection and Iterative Method.                                                                                                                                                                                                                                                                                                |                                                                                                                    |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>MAGNETIC RESONANCE IMAGING</b>                                                                                  | <b>9 Periods</b> |  |
| Fundamentals of Magnetic Resonance - Interaction of Nuclei: Static Magnetic Field, Radiofrequency Wave, Rotation and Precession - Induction of Magnetic Resonance Signals – Bulk Magnetization, Relaxation Processes T1 and T2 - Block Diagram Approach of MRI System - System Magnets: Permanent, Electromagnet - Super Conductors - Gradient Magnetic Fields - Radio Frequency Coils - Shim Coils - Electronic Components - fMRI.                                                                                       |                                                                                                                    |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>NUCLEAR IMAGING SYSTEM</b>                                                                                      | <b>9 Periods</b> |  |
| Radioisotopes: Alpha, Beta, and Gamma Radiations – Radiopharmaceuticals - Radiation Detectors: Proportional Counter, GM Counter and Scintillation Detectors - Gamma Camera: Principle of Operation, Collimator, Photomultiplier Tube, X-Y Positioning Circuit, Pulse Height Analyzer - Principles of SPECT and PET.                                                                                                                                                                                                       |                                                                                                                    |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>RADIATION THERAPY AND RADIATION SAFETY</b>                                                                      | <b>9 Periods</b> |  |
| Effects of Radiation: Direct and Indirect - Radiation Therapy: Linear Accelerator, TeleGamma Machine - Recent Techniques in Radiation Therapy - Stereotaxic Radiotherapy and Radiosurgery, 3D CRT, IMRT, IGRT and CyberKnife - Radiation Measuring Instruments: Dosimeter, Film Badges, Thermo Luminescent Dosimeters and Electronic Dosimeter - Radiation Protection in Medicine: Radiation Protection Principles, International Commission on Radiological Protection (ICRP) and Atomic Energy Regulatory Board (AERB). |                                                                                                                    |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                    |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                    |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                                          |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Anthony B. Wolbarst, Patrizio Capasso and Andrew R. Wyant, " <b>Medical Imaging: Essentials for Physicians</b> ", John Wiley & Sons, Inc, 1 <sup>st</sup> Edition, 2013. |
| 2 | Barton F. Branstetter, " <b>Practical Imaging Informatics: Foundations and Applications for Medical Imaging</b> ", Springer, 2 <sup>nd</sup> Edition, 2021.              |

**REFERENCES:**

|   |                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Jerrold T. Bushberg, J. Anthony Seibert, Edwin M. Leidholdt and John M. Boone, " <b>The Essential Physics of Medical Imaging</b> ", Lippincott Williams and Wilkins, 3 <sup>rd</sup> Edition, 2012. |
| 2 | R. Hendee and Russell Ritenour, " <b>Medical Imaging Physics</b> ", William Wiley- Liss, 4 <sup>th</sup> Edition, 2002.                                                                             |
| 3 | Gopal B. Saha, " <b>Physics and Radiobiology of Nuclear Medicine</b> ", Springer, 3 <sup>rd</sup> Edition, 2006.                                                                                    |
| 4 | P. Ragunathan, " <b>Magnetic Resonance Imaging and Spectroscopy in Medicine concepts and Techniques</b> ", Orient Longman, 1 <sup>st</sup> Edition, 2007.                                           |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                              | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Explain the components and working principle of X-ray machines.              | K2                                     |
| CO2                                                                                   | Compare the techniques involved in CT imaging system                         | K2                                     |
| CO3                                                                                   | Describe about MRI and its significance over X-ray and CT                    | K2                                     |
| CO4                                                                                   | Identify the applications of nuclear imaging system in the field of medicine | K3                                     |
| CO5                                                                                   | Summarize the effects of radiation and its safety methods.                   | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                            |          |          |          |     |     |          |     |     |      |      |      |          |          |      |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|-----|-----|----------|-----|-----|------|------|------|----------|----------|------|
| COs/POs                                             | PO1                                                                                                                                        | PO2      | PO3      | PO4      | PO5 | PO6 | PO7      | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1     | PSO2     | PSO3 |
| CO1                                                 | 2                                                                                                                                          | 3        | 1        | 1        | -   | -   | 2        | -   | -   | -    | -    | -    | 1        | 2        | -    |
| CO2                                                 | 2                                                                                                                                          | 3        | 1        | 1        | -   | -   | 2        | -   | -   | -    | -    | -    | 1        | 2        | -    |
| CO3                                                 | 2                                                                                                                                          | 3        | 1        | 1        | -   | -   | 2        | -   | -   | -    | -    | -    | 1        | 2        | -    |
| CO4                                                 | 2                                                                                                                                          | 3        | 1        | 1        | -   | -   | 2        | -   | -   | -    | -    | -    | 1        | 2        | -    |
| CO5                                                 | 2                                                                                                                                          | 3        | 1        | 1        | -   | -   | 2        | -   | -   | -    | -    | -    | 1        | 2        | -    |
| <b>22NPES20</b>                                     | <b>2</b>                                                                                                                                   | <b>3</b> | <b>1</b> | <b>1</b> | -   | -   | <b>2</b> | -   | -   | -    | -    | -    | <b>1</b> | <b>2</b> | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                            |          |          |          |     |     |          |     |     |      |      |      |          |          |      |
| CO1                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.1.4, 3.1.5, 3.1.6, 4.2.1, 7.1.1, 7.1.2 |          |          |          |     |     |          |     |     |      |      |      |          |          |      |
| CO2                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.1.4, 3.1.5, 3.1.6, 4.2.1, 7.1.1, 7.1.2 |          |          |          |     |     |          |     |     |      |      |      |          |          |      |
| CO3                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.1.4, 3.1.5, 3.1.6, 4.2.1, 7.1.1, 7.1.2 |          |          |          |     |     |          |     |     |      |      |      |          |          |      |
| CO4                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.1.4, 3.1.5, 3.1.6, 4.2.1, 7.1.1, 7.1.2 |          |          |          |     |     |          |     |     |      |      |      |          |          |      |
| CO5                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.1.4, 3.1.5, 3.1.6, 4.2.1, 7.1.1, 7.1.2 |          |          |          |     |     |          |     |     |      |      |      |          |          |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 40                   | 40             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 40                   | 40             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 40                   | 40             |                 |                   |                 | 100     |

|                 |                                 |
|-----------------|---------------------------------|
| <b>22NPES21</b> | <b>MEDICAL IMAGE PROCESSING</b> |
|-----------------|---------------------------------|

| PREREQUISITES                                                       | CATEGORY | L | T | P | C |
|---------------------------------------------------------------------|----------|---|---|---|---|
| 1. 22NPES19 DIGITAL IMAGE PROCESSING<br>2. 22NPES20 MEDICAL IMAGING | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                       |                  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                      | To teach the concepts and techniques for processing of medical images |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                              | <b>FUNDAMENTALS OF IMAGE PROCESSING</b>                               | <b>9 Periods</b> |  |
| Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationship between Pixels - Color Image Fundamentals – 2D Mathematical Preliminaries - 2D Transforms.                                                                                                                                                                                                    |                                                                       |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>MEDICAL IMAGE ENHANCEMENT</b>                                      | <b>9 Periods</b> |  |
| Image Enhancement Operations – Image Noise and Modeling - Image Restoration – Image Degradation Model - Medical Image Enhancement: Spatial Domain Filters, Frequency Domain Filters.                                                                                                                                                                                                                         |                                                                       |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                            | <b>MEDICAL IMAGE RECONSTRUCTION</b>                                   | <b>9 Periods</b> |  |
| Mathematical Preliminaries - Basic Reconstruction Methods - Image Reconstruction in CT Scanners, MRI, fMRI - Ultrasound Imaging - 3D Ultrasound Imaging - Nuclear Medical Imaging Modalities: SPECT, PET, Molecular Imaging.                                                                                                                                                                                 |                                                                       |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>IMAGE SEGMENTATION AND ANALYSIS</b>                                | <b>9 Periods</b> |  |
| Image Segmentation: Pixel, Edge and Region based Segmentation - Active Contour Models - Level sets for Medical Image Segmentation - Image Representation and Analysis.                                                                                                                                                                                                                                       |                                                                       |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                              | <b>IMAGE CLASSIFICATION AND REGISTRATION</b>                          | <b>9 Periods</b> |  |
| Feature Extraction and Representation - Statistical, Shape, Texture Features - Statistical and Neural Network based Image Classification - Image Registration: Rigid Body Transformation – Affine Transformation - Principal Axes Registration -Feature based Registration - Elastic Deformation based Registration - Registration of Images from Different Modalities - Evaluation of Registration Methods. |                                                                       |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                           |                                                                       |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                         |                                                                       |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                           |
|---|-------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Geoff Dougherty, “ <b>Digital Image Processing for Medical Applications</b> ”, Cambridge University Press, 1 <sup>st</sup> Edition, 2010. |
| 2 | Kavyan Najarian and Robert Splerstor, “ <b>Biomedical Signals and Image processing</b> ”, CRC Press, 2 <sup>nd</sup> Edition, 2012.       |

**REFERENCES:**

|   |                                                                                                                                                                                    |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Rafael C. Gonzalez, Richard E. Woods, “ <b>Digital Image Processing</b> ”, Pearson Education India Ltd., 4 <sup>th</sup> Edition, 2018.                                            |
| 2 | Atam P.Dhawan, “ <b>Medical Image Analysis</b> ”, John Wiley & Sons, Inc., 2 <sup>nd</sup> Edition, 2011.                                                                          |
| 3 | Ravikanth Malladi, “ <b>Geometric Methods in Bio-Medical Image Processing (Mathematics and Visualization)</b> ”, Springer-Verlag Berlin Heidelberg, 1 <sup>st</sup> Edition, 2002. |
| 4 | A. Ardeshtir Goshtasby, “ <b>Image Registration Principles, Tools and Methods (Advances in Computer Vision and Pattern Recognition)</b> ”, Springer, 2014.                         |

| <b>COURSE OUTCOMES</b>                                      |                                                                          | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                          |                                |
| CO1                                                         | Explain the concepts of digital image processing.                        | K2                             |
| CO2                                                         | Illustrate image pre-processing techniques for medical image processing. | K3                             |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|     |                                                                                            |    |
|-----|--------------------------------------------------------------------------------------------|----|
| CO3 | Summarize medical imaging and reconstruction methods for high dimensionality visualization | K3 |
| CO4 | Analyze image segmentation in medical images                                               | K4 |
| CO5 | Apply image processing algorithms to classify and register medical images                  | K4 |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping                             |                                                                                                                                                   |          |          |          |     |     |     |     |     |      |      |      |          |      |      |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|-----|-----|-----|-----|-----|------|------|------|----------|------|------|
| COs/POs                                      | PO1                                                                                                                                               | PO2      | PO3      | PO4      | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1     | PSO2 | PSO3 |
| CO1                                          | 3                                                                                                                                                 | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | -    | -    |
| CO2                                          | 3                                                                                                                                                 | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | -    | -    |
| CO3                                          | 3                                                                                                                                                 | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | -    | -    |
| CO4                                          | 3                                                                                                                                                 | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | -    | -    |
| CO5                                          | 3                                                                                                                                                 | 3        | 1        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | 2        | -    | -    |
| <b>22NPES21</b>                              | <b>3</b>                                                                                                                                          | <b>3</b> | <b>1</b> | <b>2</b> | -   | -   | -   | -   | -   | -    | -    | -    | <b>2</b> | -    | -    |
| b) CO and Key Performance Indicators mapping |                                                                                                                                                   |          |          |          |     |     |     |     |     |      |      |      |          |      |      |
| CO1                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4 |          |          |          |     |     |     |     |     |      |      |      |          |      |      |
| CO2                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4 |          |          |          |     |     |     |     |     |      |      |      |          |      |      |
| CO3                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4 |          |          |          |     |     |     |     |     |      |      |      |          |      |      |
| CO4                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4 |          |          |          |     |     |     |     |     |      |      |      |          |      |      |
| CO5                                          | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4 |          |          |          |     |     |     |     |     |      |      |      |          |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 40                   | 40             |                 |                   |                 | 100     |
| CAT2                                                         |                   | 20                   | 40             | 40              |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 50             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   |                      | 50             | 50              |                   |                 | 100     |
| ESE                                                          | 30                | 30                   | 20             | 20              |                   |                 | 100     |

|                 |                         |
|-----------------|-------------------------|
| <b>22NPES22</b> | <b>MEDICAL ROBOTICS</b> |
|-----------------|-------------------------|

| PREREQUISITES                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                   | CATEGORY | L | T | P         | C |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|----------|---|---|-----------|---|
| NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                   | PE       | 3 | 0 | 0         | 3 |
| COURSE OBJECTIVE                                                                                                                                                                                                                                                                                                                                                                                                                                       | To impart knowledge on different types of robots and their applications in the field of medicine. |          |   |   |           |   |
| UNIT - I                                                                                                                                                                                                                                                                                                                                                                                                                                               | INTRODUCTION TO ROBOTICS                                                                          |          |   |   | 9 Periods |   |
| Introduction to Robotics - Overview of Robot Subsystems - Degrees of Freedom – Configurations and Concept of Workspace - Dynamic Stabilization – Sensors: Sensors and Controllers, Internal and External Sensors, Position, Velocity, Acceleration, Proximity Sensors and Force sensors - Actuators: Pneumatic and Hydraulic Actuators, Stepper Motor Control Circuits, End Effectors, Various Types of Grippers, PD and PID Feedback Actuator Models. |                                                                                                   |          |   |   |           |   |
| UNIT - II                                                                                                                                                                                                                                                                                                                                                                                                                                              | MANIPULATORS & BASIC KINEMATICS                                                                   |          |   |   | 9 Periods |   |
| Construction of Manipulators - Manipulator Dynamic and Force Control - Electronic and Pneumatic Manipulator - Machinery Vision – Ranging: Laser, Acoustic, Magnetic, Fiber Optic and Tactile Sensor.                                                                                                                                                                                                                                                   |                                                                                                   |          |   |   |           |   |
| UNIT - III                                                                                                                                                                                                                                                                                                                                                                                                                                             | SURGICAL ROBOTS                                                                                   |          |   |   | 9 Periods |   |
| Da Vinci Surgical System - Image guided Robotic Systems - Focal Ultrasound based Surgical Applications - Robotic Tele-surgical System: CABG, Urologic, Cardiac, Neuro, Pediatric, and Gynecologic Surgery - nanorobotics.                                                                                                                                                                                                                              |                                                                                                   |          |   |   |           |   |
| UNIT - IV                                                                                                                                                                                                                                                                                                                                                                                                                                              | REHABILITATION AND ASSISTIVE ROBOTS                                                               |          |   |   | 9 Periods |   |
| Pediatric Rehabilitation - Robotic Therapy for the Upper Extremity and Walking - Clinical-Based Gait Rehabilitation Robots - Motion Correlation and Tracking - Motion Prediction - Motion Replication - Portable Robot for Tele Rehabilitation - Robotic Exoskeletons: Design considerations, Hybrid Assistive Limb.                                                                                                                                   |                                                                                                   |          |   |   |           |   |
| UNIT - V                                                                                                                                                                                                                                                                                                                                                                                                                                               | WEARABLE ROBOTS                                                                                   |          |   |   | 9 Periods |   |
| Kinematics and Dynamics for Wearable Robots - Wearable Robot Technology: Sensors, Actuators, Portable Energy Storage - Human–Robot Cognitive Interaction (cHRI) - Human–Robot Physical Interaction (pHRI) - Wearable Robotic Communication.                                                                                                                                                                                                            |                                                                                                   |          |   |   |           |   |
| Contact Periods: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                   |          |   |   |           |   |
| Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods                                                                                                                                                                                                                                                                                                                                                          |                                                                                                   |          |   |   |           |   |

**TEXT BOOKS:**

|   |                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------|
| 1 | Jocelyne Troccaz, " <b>Medical Robotics</b> ", JohnWiley & Sons, Inc., 2013.                             |
| 2 | Achim Schweikard and Floris Ernst, " <b>Medical Robotics</b> ", Springer, 2 <sup>nd</sup> Edition, 2015. |

**REFERENCES:**

|   |                                                                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Spong and Vidhyasagar, " <b>Robot Dynamics and Control</b> ", John Wiley and Sons, 1 <sup>st</sup> Edition, 2008.                                                     |
| 2 | Shane Xie, " <b>Advanced Robotics for Medical Rehabilitation - Current State of the Art and Recent Advances</b> ", Springer, 2016.                                    |
| 3 | Jacob Rosen, Blake Hannaford and Richard M Satava, " <b>Surgical Robotics: System Applications &amp; Visions</b> ", Springer, 2011.                                   |
| 4 | Fu.K.S, Gonzalez. R.C. and Lee, C.S.G, " <b>Robotics: Control, Sensing, Vision and Intelligence</b> ", Tata McGraw Hill International, 1 <sup>st</sup> Edition, 2008. |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b>                                      |                                                                       | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-----------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                       |                                |
| CO1                                                         | Describe the concept of sensors and actuators for robot configuration | K2                             |
| CO2                                                         | Explain the function of robotic manipulators and kinematics           | K2                             |
| CO3                                                         | Identify suitable robots for different surgical applications          | K3                             |
| CO4                                                         | Comprehend the robotic systems for rehabilitation                     | K2                             |
| CO5                                                         | Summarize the concept of wearable robots                              | K2                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                                 |          |          |     |     |     |     |     |     |      |      |      |      |          |          |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|-----|-----|-----|-----|-----|-----|------|------|------|------|----------|----------|
| COs/POs                                             | PO1                                                                                                                                                             | PO2      | PO3      | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2     | PSO3     |
| CO1                                                 | 3                                                                                                                                                               | 3        | 2        | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3        | 1        |
| CO2                                                 | 3                                                                                                                                                               | 3        | 2        | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3        | 1        |
| CO3                                                 | 3                                                                                                                                                               | 3        | 2        | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3        | 1        |
| CO4                                                 | 3                                                                                                                                                               | 3        | 2        | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3        | 1        |
| CO5                                                 | 3                                                                                                                                                               | 3        | 2        | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3        | 1        |
| <b>22NPES22</b>                                     | <b>3</b>                                                                                                                                                        | <b>3</b> | <b>2</b> | -   | -   | -   | -   | -   | -   | -    | -    | -    | -    | <b>3</b> | <b>1</b> |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                                 |          |          |     |     |     |     |     |     |      |      |      |      |          |          |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1 |          |          |     |     |     |     |     |     |      |      |      |      |          |          |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1 |          |          |     |     |     |     |     |     |      |      |      |      |          |          |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1 |          |          |     |     |     |     |     |     |      |      |      |      |          |          |
| CO4                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1 |          |          |     |     |     |     |     |     |      |      |      |      |          |          |
| CO5                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1 |          |          |     |     |     |     |     |     |      |      |      |      |          |          |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 40                | 60                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 50                | 50                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 60                   | 40             |                 |                   |                 | 100     |
| ESE                                                          | 40                | 40                   | 20             |                 |                   |                 | 100     |

|                 |                                             |
|-----------------|---------------------------------------------|
| <b>22NPES23</b> | <b>DIAGNOSTIC AND THERAPEUTIC EQUIPMENT</b> |
|-----------------|---------------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                 |                  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                        | To impart knowledge on medical equipment for cardiology, myology and neurology. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                | <b>CARDIAC EQUIPMENT</b>                                                        | <b>9 Periods</b> |  |
| Electrocardiograph - Normal and Abnormal Waveform, Heart Rate Monitor, Heart Rate Variability, Holter Monitor - Cardiac Pacemaker: Internal and External Pacemaker, Types, Batteries - AC and DC Defibrillator: Internal and External, Types - Precautions                                                                                                                                                     |                                                                                 |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                               | <b>NEUROLOGICAL EQUIPMENT</b>                                                   | <b>9 Periods</b> |  |
| Multi Channel EEG Recording System - Clinical Significance of EEG - Sleep Patterns: Epilepsy, Evoked Potential – Visual, Auditory and Somatosensory, EEG Biofeedback Instrumentation, Psychophysiological Measurements for Testing Sensory Responses – Magneto Encephalo Graph (MEG): Sensing, Principle and Instrumentation                                                                                   |                                                                                 |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                              | <b>MUSCULAR EQUIPMENT</b>                                                       | <b>9 Periods</b> |  |
| EMG: Recording and Analysis of EMG Waveforms, Fatigue Characteristics, Muscle Stimulators - Nerve Stimulators - Nerve Conduction Velocity Measurement - EMG Biofeedback Instrumentation - Electro Gastro Graph (EGG) - Magneto Myo Graph (MMG).                                                                                                                                                                |                                                                                 |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                               | <b>PATIENT MONITORING AND BIOTELEMETRY</b>                                      | <b>9 Periods</b> |  |
| Patient Monitoring Systems: ICU/CCU Equipment, Infusion Pumps, Bedside Monitors, Central Monitoring Console - Architecture of Biotelemetry System – Single and Multi-Channel Biotelemetry - Inductively Coupled Biotelemetry - Optical Biotelemetry - Readout Formats - Concept of m-Health 2.0 - Point of Care Devices – Disposable Hematology Sensors.                                                       |                                                                                 |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                | <b>SPECIAL DIAGNOSTIC TECHNIQUES</b>                                            | <b>9 Periods</b> |  |
| Need for Heart Lung Machine - Functioning of Bubble, Disc Type and Membrane Type Oxygenators - Dialyser : Hemodialysis and Peritoneal Dialysis Unit - Wearable Artificial Kidney – Lithotripsy - Cryogenic technique – Thermography: Recording Principle and Clinical Application – Tonometer - Auto Refractometer - Audiometer: Beksey’s Type, Pure Tone, Speech - Galvanic Skin Resistance (GSR) - Polygraph |                                                                                 |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                             |                                                                                 |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                           |                                                                                 |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Joseph J. Carr and John M. Brown, <i>“Introduction to Biomedical Equipment Technology”</i> , Pearson Education, 4 <sup>th</sup> Edition, 2014. |
| 2 | John G. Webster, <i>“Medical Instrumentation Application and Design”</i> , 4 <sup>th</sup> Edition, John Wiley and Sons, New York, 2009.       |

**REFERENCES:**

|   |                                                                                                                                                                        |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Myer Kutz, <i>“Biomedical Engineering &amp; Design Handbook: Volume 2”</i> , McGraw-Hill Publisher, 2 <sup>nd</sup> Edition, 2009.                                     |
| 2 | L.A Geddes and L.E.Baker, <i>“Principles of Applied Biomedical Instrumentation”</i> , John Wiley and Sons, 3 <sup>rd</sup> Edition, 2008.                              |
| 3 | Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, <i>“Biomedical Instrumentation and Measurements”</i> , Pearson Education India, 2 <sup>nd</sup> Edition, 2015. |
| 4 | Antony Y.K.Chan, <i>“Biomedical Device Technology, Principles and Design”</i> , Charles Thomas Publisher Ltd, 2008.                                                    |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                           | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Explain different medical devices or the measurement of parameters related to cardiology  | K2                                     |
| CO2                                                                                   | Elaborate different types of neurological equipment                                       | K2                                     |
| CO3                                                                                   | Analyze myographic signals and its spectrums                                              | K4                                     |
| CO4                                                                                   | Identify suitable monitoring and transmission equipment for the patient diagnosis system. | K3                                     |
| CO5                                                                                   | Interpret the features using multivariate component analysis.                             | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                                 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                             | PO1                                                                                                                                                             | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 3                                                                                                                                                               | 3        | 2        | -        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 3        | 1        |
| CO2                                                 | 3                                                                                                                                                               | 3        | 2        | -        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 3        | 1        |
| CO3                                                 | 3                                                                                                                                                               | 3        | 2        | -        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 3        | 1        |
| CO4                                                 | 3                                                                                                                                                               | 3        | 2        | -        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 3        | 1        |
| CO5                                                 | 3                                                                                                                                                               | 3        | 2        | -        | -        | -        | -        | -        | -        | -        | -        | -        | -        | 3        | 1        |
| <b>22NPE\$23</b>                                    | <b>3</b>                                                                                                                                                        | <b>3</b> | <b>2</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>3</b> | <b>1</b> |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                                 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 2.4.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 40                | 60                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 40                   | 20             | 20              |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 40                | 60                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 40                   | 40             | 20              |                   |                 | 100     |
| ESE                                                          | 20                | 40                   | 20             | 20              |                   |                 | 100     |

|                 |                                      |
|-----------------|--------------------------------------|
| <b>22NPES24</b> | <b>PHYSIOLOGICAL CONTROL SYSTEMS</b> |
|-----------------|--------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                  |                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                           | To teach the concepts of physiological control system and its significance on biological signals |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                   | <b>PHYSIOLOGICAL SYSTEMS WITH FEEDBACK</b>                                                       | <b>9 Periods</b> |
| Introduction to Biosignals: Nature of Biomedical Signals - ENG, EMG, ECG, EEG, ERP and PCG - Noise: Random, Structured and Physiological Noise – Filters: IIR, FIR and Integer Filters for ECG Analysis                                                                                                                                                                                           |                                                                                                  |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                  | <b>STEADY STATE ANALYSIS OF PHYSIOLOGICAL SYSTEM</b>                                             | <b>9 Periods</b> |
| Determination of Steady State Operating Point - Steady State Analysis - Regulation of Cardiac Output - Chemical Regulation of Ventilation - Time Domain Analysis of Linear Control Systems - Transient Response Analysis - Dynamics of Neuromuscular Reflex Motion - Frequency Domain Analysis of Linear Control Systems - Frequency Response of Circulatory Control - Glucose Insulin Regulation |                                                                                                  |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                 | <b>STABILITY ANALYSIS OF PHYSIOLOGICAL CONTROL SYSTEM</b>                                        | <b>9 Periods</b> |
| Relative Stability: Stability Analysis of Pupillary Light Reflex - Model of Cheyne-Stokes Breathing - Identification of Physiological Control Systems: Parametric Estimation, Identification of Closed Loop System.                                                                                                                                                                               |                                                                                                  |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                  | <b>MODELLING OF NERVE ACTION</b>                                                                 | <b>9 Periods</b> |
| Modelling the Nerve Action Potential: Voltage Clamp Experiment and its Interpretation, Model for the Strength Duration Curve, Modelling Skeletal Muscle Contraction, Linear Model of Muscle Contraction, Modelling Myoelectric Activity.                                                                                                                                                          |                                                                                                  |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                   | <b>PHYSIOLOGICAL SYSTEM IDENTIFICATION</b>                                                       | <b>9 Periods</b> |
| System Identification in Physiology: Modelling of Sensory Receptors - Pupil Control System - Modelling Cardiovascular System - Modelling Blood Flow - Systemic Blood Flow - Coronary Circulation - Behavior of the Immune System - Linearized Model of Immune Response to Disease                                                                                                                 |                                                                                                  |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                |                                                                                                  |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                              |                                                                                                  |                  |

**TEXT BOOKS:**

|   |                                                                                                                                                                                |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Michael C.K. Khoo, “ <b>Physiological Control Systems-Analysis Simulation and Estimation</b> ”, IEEE Press Series in Biomedical Engineering, 2000.                             |
| 2 | Suresh R. Devasahayam, “ <b>Signals and Systems in Biomedical Engineering-Signal Processing and Physiological Systems Modeling</b> ”, Kluwer Academic/Plenum Publishers, 2000. |

**REFERENCES:**

|   |                                                                                                                                                             |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | I.J.Nagrath and M.Gopal, “ <b>Control System Engineering</b> ”, New Age International Publishers, 6 <sup>th</sup> Edition, 2008.                            |
| 2 | Farid Golnaraghi, Benjamin C. Kuo, “ <b>Automatic Control Systems</b> ”, Wiley, 9 <sup>th</sup> Edition, 2014.                                              |
| 3 | Richard C. Dorf and Robert H. Bishop, “ <b>Modern Control Systems</b> ”, Prentice Hall, 12 <sup>th</sup> Edition, 2010.                                     |
| 4 | Joseph J. DiStefano, Allen R.Stubberud, Schaum's, “ <b>Outline of Feedback and Control Systems</b> ”, McGraw-Hill Education, 2 <sup>nd</sup> Edition, 2013. |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                    | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Compare and contrast conventional signal and physiological signals | K2                                     |
| CO2                                                                                   | Analyze steady state response of physiological system              | K4                                     |
| CO3                                                                                   | Obtain stability analysis of physiological control systems         | K3                                     |
| CO4                                                                                   | Analyze muscular and neurological control system                   | K4                                     |
| CO5                                                                                   | Model physiological control system                                 | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                   |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|-----|-----|-----|-----|-----|------|------|------|----------|----------|------|
| COs/POs                                             | PO1                                                                                                                                               | PO2      | PO3      | PO4      | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1     | PSO2     | PSO3 |
| CO1                                                 | 3                                                                                                                                                 | 3        | 2        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | 1        | 3        | -    |
| CO2                                                 | 3                                                                                                                                                 | 3        | 2        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | 1        | 3        | -    |
| CO3                                                 | 3                                                                                                                                                 | 3        | 2        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | 1        | 3        | -    |
| CO4                                                 | 3                                                                                                                                                 | 3        | 2        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | 1        | 3        | -    |
| CO5                                                 | 3                                                                                                                                                 | 3        | 2        | 1        | -   | -   | -   | -   | -   | -    | -    | -    | 1        | 3        | -    |
| <b>22NPE\$24</b>                                    | <b>3</b>                                                                                                                                          | <b>3</b> | <b>2</b> | <b>1</b> | -   | -   | -   | -   | -   | -    | -    | -    | <b>1</b> | <b>3</b> | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                   |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO4                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |
| CO5                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 3.3.1, 4.1.2, 4.1.4 |          |          |          |     |     |     |     |     |      |      |      |          |          |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         |                   | 60                   | 20             | 20              |                   |                 | 100     |
| CAT2                                                         |                   | 60                   | 20             | 20              |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 40                   | 40             | 20              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 40                   | 40             | 20              |                   |                 | 100     |
| ESE                                                          | 20                | 40                   | 40             |                 |                   |                 | 100     |

|                 |                        |
|-----------------|------------------------|
| <b>22NPES25</b> | <b>UNIT OPERATIONS</b> |
|-----------------|------------------------|

| <b>PREREQUISITES</b>                         | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------------------------------|-----------------|----------|----------|----------|----------|
| <b>22NPC620 PROCESS DYNAMICS AND CONTROL</b> | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                  |                  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                      | To impart knowledge on common unit operations carried out in process industries. |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                              | <b>HEAT EXCHANGE AND EVAPORATION</b>                                             | <b>9 Periods</b> |
| Introduction and classification of unit operations - Heat Exchanger: Double pipe heat exchanger - Shell and tube heat exchangers - Types of shell and tube exchanger: Fixed tube, Floating head, U-tube, Reboiler type. Evaporators: Types of evaporators – Jacketed pan, Horizontal tube, Short tube, Long tube, Forced circulation evaporator.                                                                             |                                                                                  |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                             | <b>DISTILLATION</b>                                                              | <b>9 Periods</b> |
| Concept of distillation - Boiling point diagram – Vapour liquid equilibrium - Roul't's Law - Relative volatility - Methods of distillation: Simple, Flash, Fractional -Batch Distillation - Importance of reflux ratio - Azeotrope.                                                                                                                                                                                          |                                                                                  |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                            | <b>ABSORPTION &amp; EXTRACTIONS</b>                                              | <b>9 Periods</b> |
| Basic terms of absorption - Concept of equilibrium - Gas absorption equipment's - General consideration of extraction - Equilibrium condition - Extraction Equipment's - Mixer settler - Pulsed sieve plate column - Spray column –Packed column - Pulsed column.                                                                                                                                                            |                                                                                  |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                             | <b>CRYSTALLIZATION &amp; DRYING</b>                                              | <b>9 Periods</b> |
| Concept of crystallization - Solubility and supersaturation - Methods of supersaturation - Miers supersaturation theory. Crystallizers: Agitated tank crystallizer - Vacuum crystallizer - Krystal or Oslo crystallizer. General Definitions, Principles, equilibria, Bound & unbound moisture - Construction, working and applications of drying equipment: Tray dryer, - Rotary dryer – Spray dryer - Fluidized bed Dryer. |                                                                                  |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                              | <b>APPLICATION IN PETROCHEMICAL, PAPER &amp; PULP INDUSTRY</b>                   | <b>9 Periods</b> |
| Process flow diagram of paper and pulp industry – Batch digester – Continuous sulphate digester – Control problems on the paper machine. Process flow diagram of PetroChemical Industry - Gas oil separation in production platform – wet gas processing.0                                                                                                                                                                   |                                                                                  |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                  |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                         |                                                                                  |                  |

**TEXT BOOKS:**

|   |                                                                                                                                       |
|---|---------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>K.A. Gavhane, "Unit operations -II (heat &amp; mass transfer)" Nirali Prakashan, 2014.</i>                                         |
| 2 | <i>Warren L. McCabe , Julian C. Smith &amp; Peter Harriot "Unit operations in Chemical Engineering", McGraw-Hill Education, 2014.</i> |

**REFERENCES:**

|   |                                                                                                                                                  |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Liptak B.G., "Instrument and Automation Engineers' Handbook: Process Measurement and Analysis", CRC Press, 5<sup>th</sup> Edition,, 2016.</i> |
| 2 | <i>Chattopadhyaya "Unit Operations of Chemical Engineering Vol I &amp; II", Khanna Publishers,, 1996.</i>                                        |
| 3 | <i>Coulson and Richardson., J.F., "Chemical Engineering Vols I &amp; II" , Elsevier Science, 5<sup>th</sup> Edition 2002.</i>                    |
| 4 | <i>Christie Geankoplis "Transport Process Principles and Unit Operations", Prentice Hall of India, 2013.</i>                                     |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                                      | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Comprehend principle operation of heat exchanger and evaporators.                                    | K2                                     |
| CO2                                                                                   | Summarize distillation concepts and its types.                                                       | K2                                     |
| CO3                                                                                   | Describe absorption and extraction equipment to analyze their effectiveness in separation processes. | K2                                     |
| CO4                                                                                   | Elaborate the working of different types of crystallizers.                                           | K2                                     |
| CO5                                                                                   | Discuss the working principle of various drying processes and equipment required.                    | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                        | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                          | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| CO2                                                 | 2                                                          | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| CO3                                                 | 2                                                          | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| CO4                                                 | 2                                                          | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| CO5                                                 | 2                                                          | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| <b>22NPE\$25</b>                                    | 2                                                          | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                            |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2,3.1.1,3.1.4,4.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2,3.1.1,3.1.4,4.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2,3.1.1,3.1.4,4.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2,3.1.1,3.1.4,4.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1,1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.2,3.1.1,3.1.4,4.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                | 70                   |                |                 |                   |                 | 100     |
| ESE                                                          | 30                | 70                   |                |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|          |                        |
|----------|------------------------|
| 22NPES26 | INTELLIGENT AUTOMATION |
|----------|------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                            |                                                                                                                                   |                  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                    | To instill the concepts and methods of problem solving using Artificial Intelligence to attain industrial automation and control. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                            | <b>INTRODUCTION TO AUTOMATION</b>                                                                                                 | <b>9 Periods</b> |  |
| Introduction to Industrial Automation – Automation in production system – Principles and Strategies of Automation – Basic Elements of an Automated System – Advanced Automation Functions – Levels of Automation – Methods of Evaluating Investment Alternatives.          |                                                                                                                                   |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                           | <b>INTRODUCTION TO ARTIFICIAL INTELLIGENCE</b>                                                                                    | <b>9 Periods</b> |  |
| Introduction to Artificial Intelligence – Foundations of AI – Intelligent Agents and Environment – Reactive agent – Deliberative – Goal Driven – Utility driven and learning agents – Artificial Intelligence programming Techniques - Introduction to ML and DL Concepts. |                                                                                                                                   |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                          | <b>KNOWLEDGE AND REASONING</b>                                                                                                    | <b>9 Periods</b> |  |
| Knowledge representation, Cycle of Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge. |                                                                                                                                   |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                           | <b>EXPERT SYSTEMS</b>                                                                                                             | <b>9 Periods</b> |  |
| Expert Systems – Architecture, Roles of expert systems, Knowledge Acquisition – Meta Knowledge – Heuristics -MOLE, SALT. Typical Expert systems -MYCIN, DART, DENTRAL, XOON                                                                                                |                                                                                                                                   |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                            | <b>AI IN CONTROL SYSTEMS</b>                                                                                                      | <b>9 Periods</b> |  |
| Industrial AI Applications and case studies – Applications of Industrial AI in Monitoring optimization and control – Intelligent control methods.                                                                                                                          |                                                                                                                                   |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                         |                                                                                                                                   |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                       |                                                                                                                                   |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Elaine Rich and Kelvin Knight, “ <b>Artificial Intelligence</b> ”, Tata McGraw Hill, 1st Edition, 2014.                             |
| 2 | M.P.Groover, “ <b>Automation, Production Systems and Computer Integrated Manufacturing</b> ”, Pearson Education, 5th edition, 2009. |

**REFERENCES:**

|   |                                                                                                                           |
|---|---------------------------------------------------------------------------------------------------------------------------|
| 1 | Nilson.N.J., “ <b>Principles of Artificial Intelligence</b> ”, Springer Verlag, Berlin, 1980.                             |
| 2 | Stuart Russell and Peter Norvig, “ <b>Artificial Intelligence: A Modern Approach</b> ”, 2nd Edition, Prentice Hall, 2003. |
| 3 | Eugene Charniak and Drew McDermot, “ <b>Introduction to Artificial Intelligence</b> ”, Addison Wesley Longman Inc., 1998. |
| 4 | Rajiv Chopra, “ <b>Deep Learning</b> ”, 1st edition, Khanna Publishing House, 2018.                                       |
| 5 | Spyros.G.Tzafestas, “ <b>Methods and Applications of Intelligent control</b> ”, Kluwer Academic Publishers, 1997.         |

| COURSE OUTCOMES                                             |                                                                 | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|-----------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                 |                         |
| CO1                                                         | Understand the basics of Industrial automation                  | K2                      |
| CO2                                                         | Choose appropriate AI methods for problem solving.              | K2                      |
| CO3                                                         | Familiarize about AI/ML/DL techniques in Industrial Automation. | K2                      |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                 |    |
|-----|-------------------------------------------------|----|
| CO4 | Identify the different Expert systems.          | K2 |
| CO5 | Explain the need of AI in control applications. | K3 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                    |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|----------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                             | PO1                                                | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 3                                                  | 3        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO2                                                 | 3                                                  | 3        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO3                                                 | 3                                                  | 2        | 2        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO4                                                 | 3                                                  | 2        | 3        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO5                                                 | 3                                                  | 2        | 2        | 2        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| <b>22NPE\$26</b>                                    | <b>3</b>                                           | <b>3</b> | <b>3</b> | <b>2</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>-</b> | <b>2</b> | <b>1</b> |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                    |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,10.1.1,11.3.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,10.1.1,11.3.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,10.1.1,11.3.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,10.1.1,11.3.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,10.1.1,11.3.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 30                | 30                   | 40             |                |                   |                 | 100     |
| CAT2                                                         | 30                | 30                   | 40             |                |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 50                |                      | 50             |                |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 50             |                |                   |                 | 100     |
| ESE                                                          | 30                | 20                   | 50             |                |                   |                 | 100     |

|          |                               |
|----------|-------------------------------|
| 22NPES27 | ROBOTICS AND ITS APPLICATIONS |
|----------|-------------------------------|

| PREREQUISITES                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                           | CATEGORY | L | T | P | C         |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|----------|---|---|---|-----------|
| NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                           | PE       | 3 | 0 | 0 | 3         |
| COURSE OBJECTIVE                                                                                                                                                                                                                                                                                                                                                                                                                                      | To provide knowledge about the kinematics, types of drives, and sensors used in robotics. |          |   |   |   |           |
| UNIT - I                                                                                                                                                                                                                                                                                                                                                                                                                                              | FUNDAMENTALS OF ROBOT                                                                     |          |   |   |   | 9 Periods |
| Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load –Robot Parts and their functions – Need for Robots – Different Applications.                                                                                                                                                                                        |                                                                                           |          |   |   |   |           |
| UNIT - II                                                                                                                                                                                                                                                                                                                                                                                                                                             | ROBOT KINEMATICS                                                                          |          |   |   |   | 9 Periods |
| Forward kinematics, inverse kinematics and their difference - forward kinematics and inverse Kinematics of Manipulators with two, three, four degrees of freedom – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.                                                                                                                                                                                  |                                                                                           |          |   |   |   |           |
| UNIT - III                                                                                                                                                                                                                                                                                                                                                                                                                                            | ROBOT DRIVE SYSTEMS AND END EFFECTORS                                                     |          |   |   |   | 9 Periods |
| Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – Salient Features, Applications and Comparison - End Effectors – Grippers: Mechanical, Pneumatic and Hydraulic, Magnetic, vacuum, internal and external grippers, selection and design considerations of a gripper                                                                                                                                                       |                                                                                           |          |   |   |   |           |
| UNIT - IV                                                                                                                                                                                                                                                                                                                                                                                                                                             | SENSORS IN ROBOTICS                                                                       |          |   |   |   | 9 Periods |
| Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition |                                                                                           |          |   |   |   |           |
| UNIT - V                                                                                                                                                                                                                                                                                                                                                                                                                                              | PROGRAMMING AND APPLICATIONS OF ROBOT                                                     |          |   |   |   | 9 Periods |
| Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.                                                                                                                                                                 |                                                                                           |          |   |   |   |           |
| Contact Periods: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                           |          |   |   |   |           |
| Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods                                                                                                                                                                                                                                                                                                                                                         |                                                                                           |          |   |   |   |           |

**TEXT BOOKS:**

|   |                                                                                                                                         |
|---|-----------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Mikell.P.Groover , “ <i>Industrial Robotics – Technology, Programming and applications</i> ” 2 <sup>nd</sup> Edition,McGraw Hill, 2012. |
| 2 | Jazar, “ <i>Theory of Applied Robotics: Kinematics, Dynamics and Control</i> ”, Springer India reprint, 2010.                           |

**REFERENCES:**

|   |                                                                                                                                              |
|---|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Ganesh.S.Hedge, “ <i>A textbook of Industrial Robotics</i> ”, Lakshmi Publications, 2006                                                     |
| 2 | Fu K.S. Gonalz R.C. and ice C.S.G. “ <i>Robotics Control, Sensing, Vision and Intelligence</i> ”, 3 <sup>rd</sup> edition,McGraw Hill, 2007. |
| 3 | YoramKoren, “ <i>Robotics for Engineers</i> ”, 2 <sup>nd</sup> edition,McGraw Hill., 2002.                                                   |
| 4 | Janakiraman P.A., “ <i>Robotics and Image Processing</i> ”, 4 <sup>th</sup> edition, Tata McGraw Hill 2005.                                  |

| COURSE OUTCOMES                                             |                                                                          | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                          |                         |
| CO1                                                         | Interpret the features of robots and technology involved in the control. | K2                      |
| CO2                                                         | Apply the basic engineering knowledge and laws for the design of robots  | K3                      |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                                                                 |    |
|-----|-------------------------------------------------------------------------------------------------|----|
| CO3 | Explain the basic concepts of end effectors, grippers and sensors used in robots.               | K3 |
| CO4 | Explain the concept of kinematics, degeneracy, dexterity and trajectory planning                | K3 |
| CO5 | Discuss various programming languages and the role of robots in various industrial applications | K2 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                            |          |          |          |          |          |          |          |          |          |          |          |          |          |          |  |
|-----------------------------------------------------|--------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|--|
| COs/POs                                             | PO1                                        | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |  |
| CO1                                                 | 2                                          | 2        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |  |
| CO2                                                 | 2                                          | 2        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |  |
| CO3                                                 | 3                                          | 2        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |  |
| CO4                                                 | 2                                          | 2        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |  |
| CO5                                                 | 1                                          | -        | 1        | 1        | -        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |  |
| <b>22NPE\$27</b>                                    | <b>2</b>                                   | <b>2</b> | <b>1</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>-</b> | <b>2</b> | <b>1</b> |  |
| <b>b) CO and Key Performance Indicators mapping</b> |                                            |          |          |          |          |          |          |          |          |          |          |          |          |          |          |  |
| CO1                                                 | 1.1.1,1.1.2,2.1.1,2.1.2,3.1.1,4.1.1,12.1.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |  |
| CO2                                                 | 1.1.1,1.1.2,2.1.1,2.1.2,3.1.1,4.1.1,12.1.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |  |
| CO3                                                 | 1.1.1,1.1.2,2.1.1,2.1.2,3.1.1,4.1.1,12.1.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |  |
| CO4                                                 | 1.1.1,1.1.2,2.1.1,2.1.2,3.1.1,4.1.1,12.1.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |  |
| CO5                                                 | 1.1.1,3.1,4.1.1,12.1.1                     |          |          |          |          |          |          |          |          |          |          |          |          |          |          |  |

**ASSESSMENT PATTERN – THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 40                   | 40             |                |                   |                 | 100     |
| CAT2                                                         | 20                | 40                   | 40             |                |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 50             |                |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 50             |                |                   |                 | 100     |
| ESE                                                          | 30                | 50                   | 20             |                |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                        |
|-----------------|------------------------------------------------------------------------|
| <b>22NPES28</b> | <b>INDUSTRIAL INTERNET OF THINGS</b><br>(Common to ECE & EIE Branches) |
|-----------------|------------------------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                             |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                     | To impart students the underpinning knowledge on the architecture, key technology enablers, protocols , and artificial intelligence for Industrial IoT and their use cases. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                             | <b>INTRODUCTION TO IIoT</b>                                                                                                                                                 | <b>9 Periods</b> |  |
| Digitization, Digitalization and Digital Transformation - Cyber Physical Systems - IIoT vs. IoT - ISA 95 Framework & Layers – Introduction to Industry 4.0 and its evolution- IIoT Key technologies enablers: Cyber Security, Cloud Computing, Edge Computing, and Data mining - Benefits of IIoT - IIoT concerns and risks |                                                                                                                                                                             |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                            | <b>IIoT ARCHITECTURE</b>                                                                                                                                                    | <b>9 Periods</b> |  |
| IIoT Architecture: IIoT Requirements - Introduction to Sensors- Characteristics- Categories- Smart Sensor-Actuators - Overview of service-oriented architecture-based device integration - Role of Key technologies for IIoT: Augmented Reality and Virtual Reality                                                         |                                                                                                                                                                             |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                           | <b>COMMUNICATION PROTOCOLS FOR IIoT</b>                                                                                                                                     | <b>9 Periods</b> |  |
| IEEE 802.15.4: ZigBee, Wireless HART, MiWi, 6LoWPAN, ISA100.11a - Z Wave, Bluetooth, BLE, NFC, RFID - Wireless Sensor nodes with Bluetooth, WiFi, and LoRa Protocols - MQTT, WebSocket, and HTTP Protocols- sensor networks, and multimedia sensor networks                                                                 |                                                                                                                                                                             |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                            | <b>AI and IIoT</b>                                                                                                                                                          | <b>9 Periods</b> |  |
| IIoT Analytics - Steps in Data Analytics - IIoT Basic operation using AI, ML and DL-, Overview of IoT platforms for industries:Adafruit,Thingspeak and ThingWorx.                                                                                                                                                           |                                                                                                                                                                             |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                             | <b>INDUSTRIAL IoT USE CASES</b>                                                                                                                                             | <b>9 Periods</b> |  |
| IoT applications for industry: Future Factory Concepts, Brownfield IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry- Opinions on IoT Application and Value for Industry.                                                                                       |                                                                                                                                                                             |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                          |                                                                                                                                                                             |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                        |                                                                                                                                                                             |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                                    |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Sudip Misra, Chandana Roy, Anandarup Mukherjee, <i>“Introduction to Industrial Internet of Things and Industry 4.0”</i> , CRC Press, 1 <sup>st</sup> edition, 2021 |
| 2 | Arshdeep Bahga, Vijay Madisetti, <i>“Internet of Things-A hands-on approach”</i> , Universities Press, 2015.                                                       |

**REFERENCES:**

|    |                                                                                                                                                                                               |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Andrew Minter, <i>“Analytics for the Internet of Things (IoT): Intelligent analytics for your intelligent devices”</i> , Packt Publishing, 1 <sup>st</sup> edition, July 2017.                |
| 2  | Olivier Hersent, David Boswarthick, and Omar Elloumi, <i>“The Internet of Things: Key Applications and Protocols”</i> , Wiley Publications-2011                                               |
| 3  | Alasdair Gilchrist, <i>“Industry 4.0: The Industrial Internet of Things”</i> , Apress, 2017.                                                                                                  |
| 4. | Shriram K. Vasudevan (Author), Abhishek S. Nagarajan (Author), R. M. D. Sundaram (Author) <i>Internet of Things, “Internet of Things”</i> , Wiley Publications, 2 <sup>nd</sup> Edition, 2020 |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                                      | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Discuss the IoT, IIoT differences and key technology enablers for IIoT                               | K2                                     |
| CO2                                                                                   | Demonstrate the understanding of the architecture of IIoT                                            | K2                                     |
| CO3                                                                                   | Assimilate various protocols used for IIoT                                                           | K2                                     |
| CO4                                                                                   | Comprehend the role of AI in IIoT based system                                                       | K2                                     |
| CO5                                                                                   | Identify IoT use cases in various industries and recognize the IoT project implementation modalities | K4                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                      | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO2                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO3                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO4                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO5                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| <b>22NPES28</b>                                     | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 40             | 10              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 40             | 10              |                   |                 | 100     |
| ESE                                                          | 10                | 90                   |                |                 |                   |                 | 100     |

|                 |                               |
|-----------------|-------------------------------|
| <b>22NPES29</b> | <b>DATA ANALYTICS FOR IoT</b> |
|-----------------|-------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                             |                                                                                  |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                     | To introduce students the concept of Big Data Analytics and its relevance to IoT |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                             | <b>INTRODUCTION TO TECHNOLOGICAL DEVELOPMENTS IN IoT</b>                         | <b>9 Periods</b> |
| Defining IoT Analytics and Challenges- Business value concerns, - IoT Devices and Networking Protocols basics - Analyzing data - IoT Analytics for the Cloud- Building elastic analytics - Designing for scale, Cloud security and analytics, Overview of AWS, Microsoft Azure, and ThingWorx.              |                                                                                  |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                            | <b>CLOUD ANALYTICS ENVIRONMENT</b>                                               | <b>9 Periods</b> |
| AWS Cloud Formation - AWS Virtual Private Cloud (VPC) - terminate and clean up the Environment- data processing for analytics -big data technology to storage - Apache Spark for data processing, handling change, Exploring and visualizing data -Techniques to understand data quality[ - R and R Studio. |                                                                                  |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                           | <b>GENERAL STRATEGIES ON EXTRACTING VALUE FROM DATASETS</b>                      | <b>9 Periods</b> |
| Decorating Data - Communicating with Others Visualization and Dashboarding - Applying Geospatial Analytics to IoT Data - Data Science for IoT Analytics: Overview of Machine learning (ML) and Deep learning algorithms.                                                                                    |                                                                                  |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                            | <b>SOCIETAL IMPACT OF MULTIMEDIA BIG DATA</b>                                    | <b>9 Periods</b> |
| Multimedia Social Big Data Mining - Process Model - SWOT Analysis - Techniques for Social Big Data Analytics - Advertisement Prediction - MMBD Sharing on Data Analytics Platform - Legal/Regulatory Issues                                                                                                 |                                                                                  |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                             | <b>APPLICATION ENVIRONMENTS</b>                                                  | <b>9 Periods</b> |
| Big Data Computing for IoT Applications: Precision Agriculture, Machine Learning in Improving Learning Environment, Network-Based Applications of Multimedia Big Data Computing, Recent Trends in IoT-Based Analytics and Big Data, Future Directions and Challenges of Internet of Things.                 |                                                                                  |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                          |                                                                                  |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                        |                                                                                  |                  |

**TEXT BOOKS:**

|   |                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Andrew Minter, "Analytics for the Internet of Things (IoT): Intelligent analytics for your intelligent devices", Packt Publishing, 1<sup>st</sup> edition, July 2017.</i> |
| 2 | <i>Sudeep Tanwar, Sudhanshu Tyagi, Neeraj Kumar, "Multimedia Big Data Computing for IoT Applications: Concepts, Paradigms and Solutions", Springer, 2020.</i>                |

**REFERENCES:**

|   |                                                                                                                                                                                                                                |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>John Soldatos, "Building Blocks for IoT Analytics", River Publishers Series In Signal, Image and Speech Processing, 2017.</i>                                                                                               |
| 2 | <i>Nilanjan Dey, Aboul Ella Hassanien, Chintan Bhatt, Amira S. Ashour, Suresh Chandra Satapathy, "Internet of Things and Big Data Analytics Toward Next-Generation Intelligence", Springer International Publishing, 2018.</i> |
| 3 | <i>Stackowiak, R., Licht, A., Mantha, V., Nagode, L., "Big Data and The Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015.</i>                                                               |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b>                                      |                                                     | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-----------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                     |                                |
| CO1                                                         | Discuss the Technological developments in IoT       | K2                             |
| CO2                                                         | Investigate cloud based IoT analytic environment    | K2                             |
| CO3                                                         | Apply various Big data strategies                   | K3                             |
| CO4                                                         | Explore social impact of multimedia big data        | K2                             |
| CO5                                                         | Develop solution to smart IoT systems with big data | K3                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                      | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO2                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO3                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO4                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO5                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| <b>22NPE\$29</b>                                    | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 40             | 10              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 40             | 10              |                   |                 | 100     |
| ESE                                                          | 10                | 90                   |                |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                             |
|-----------------|-----------------------------|
| <b>22NPES30</b> | <b>IoT FOR SMART CITIES</b> |
|-----------------|-----------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                  |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                     | To introduce students the implementation of IoT for Smart Cities |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>INTRODUCTION TO IoT FOR SMART CITIES</b>                      | <b>9 Periods</b> |  |
| Introduction-Characteristics of Smart Cities - IoT-Based Solutions for Smart Cities - Smart Home - Transport and Traffic Management - Challenges, Smart City Planning and Management - The Fundamentals of Smart Infrastructure - Role of Machine Learning and Deep Learning in IoT enabled Smart Cities                                                                                                    |                                                                  |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                            | <b>TECHNOLOGIES FOR IoT</b>                                      | <b>9 Periods</b> |  |
| Introduction, Communication Technologies for IoT Networks: Protocols for IoT - Overview of Secure IoT Architectures - IoT based Services for Smart Cities - Cellular Mobile Networks - Cloud IoT - Study of Communication Technologies - Intelligent Traffic System, -Disaster Management - Implementation and Comparison of MQTT, WebSocket, and HTTP Protocols for Smart Room IoT Application in Node-RED |                                                                  |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                           | <b>AI FOR SMART CITIES</b>                                       | <b>9 Periods</b> |  |
| Overview of Artificial Intelligence, Machine Learning and deep learning algorithms for smart cities - case study: smart street lighting, Smart building, Smart parking, smart irrigation, smart waste and storm water management, and Vehicle Payload Monitoring System                                                                                                                                     |                                                                  |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                            | <b>TRANSPORTATION SYSTEM IN SMART CITY</b>                       | <b>9 Periods</b> |  |
| Traffic Management for Smart Cities - Electric Vehicles in Smart Cities - EV Charging Techniques - Renewable Energy - Smart Distribution Systems - Smart Grid -Traffic Control System for Smart City using Image Processing - Interactive Analysis Platform for Bus Movement: A Case Study of One of the World's Largest Annual Gathering                                                                   |                                                                  |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                             | <b>SECURITY AND PRIVACY IN SMART CITY</b>                        | <b>9 Periods</b> |  |
| Privacy and Social Values in Smart Cities - Information Security in the Smart City - IoT Security Challenges - Blockchain Technology for IoT - Case Studies: Smart Homes, Food Supply Chain Traceability System, smart street lighting, Smart building, Smart parking, smart irrigation, Security and Privacy Threats in IoT-Enabled Smart Cities                                                           |                                                                  |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                          |                                                                  |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                        |                                                                  |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Waleed Ejaz, Alagan Anpalagan, Internet of Things for Smart Cities: Technologies, Big Data and Security, 1<sup>st</sup> ed. Springer International Publishing, 2019.</i> |
| 2 | <i>Stimmel, Carol L, Building smart cities: analytics, ICT, and design thinking, Taylor &amp; Francis, 2016.</i>                                                            |

**REFERENCES:**

|   |                                                                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Vincenzo Piuri, Rabindra Nath Shaw, Ankush Ghosh, Rabiul Islam, AI and IoT for Smart City Applications, Springer, 2022.</i>                                        |
| 2 | <i>Al-Turjman, Fadi, Intelligence in IoT-enabled smart cities, CRC Press, 2019</i>                                                                                    |
| 3 | <i>Arpan Kumar Kar, M P Gupta, P. Vigneswara Ilavarasan, Yogesh K. Dwivedi, Advances in smart cities : smarter people, governance and solutions, CRC Press, 2017.</i> |
| 4 | <i>Hammi, B., Khatoun, R., Zeadally, S., Fayad, A., &amp; Khoukhi, L. IoT technologies for smart cities, 2018.</i>                                                    |
| 5 | <i>Joel J. P. C. Rodrigues, Parul Agarwal, Kavita Khann, IoT for Sustainable Smart Cities and Society, 2022.</i>                                                      |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b>                                      |                                                                                  | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                  |                                |
| CO1                                                         | Comprehend concepts and challenges in IoT for smart cities                       | K2                             |
| CO2                                                         | Discuss key technology enablers for IoT                                          | K2                             |
| CO3                                                         | Investigate the application areas of Artificial Intelligence within smart cities | K2                             |
| CO4                                                         | Analyze transportation system and its implementation challenge in smart cities   | K3                             |
| CO5                                                         | Examine Security and privacy concerns in smart cities                            | K3                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO2                                                 | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO3                                                 | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO4                                                 | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO5                                                 | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| <b>22NPE\$30</b>                                    | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1 1.4.1, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1 1.4.1, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1 1.4.1, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1 1.4.1, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1 1.4.1, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 50             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 50             |                 |                   |                 | 100     |
| ESE                                                          | 10                | 90                   |                |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                            |
|-----------------|----------------------------|
| <b>22NPES31</b> | <b>BUILDING AUTOMATION</b> |
|-----------------|----------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                            |                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | To introduce students the important principles, components and practices in the Building Automation System |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>INTELLIGENT BUILDINGS AND BUILDING AUTOMATION SYSTEM</b>                                                | <b>9 Periods</b> |
| Intelligent Buildings: Definitions of intelligent building, Intelligent architecture and structure - Facilities management Vs. Intelligent buildings - Technology systems and evolution of intelligent buildings: Features, and Characteristics - Building Automation System (BAS) - Various Systems of Building Automation: Building Management System, Energy Management System, Security and Safety System, Video Management System.                                                                                                                                                                                                                       |                                                                                                            |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>HVAC AND CONTROL OF AIR- CONDITIONING SYSTEMS</b>                                                       | <b>9 Periods</b> |
| Introduction to HVAC – Review of Sensors, Transducers, and their Selection for HVAC: Temperature, Pressure, Level, Flow, RH, Valves, and Actuators, - Overview of Controllers for HVAC: Concept of Controller IOs, Standard Signals, Signal Compatibility between Controller and Field Devices. Air Handling Unit: Concept, Components, Working Principle.<br>Typical control loops of the air- conditioning process: Cascade control of variable air volume (VAV) systems, Sequential split- range control, on/off control - Temperature controls in AHU - Humidity controls in AHU - Static pressure control - Control of Constant Air Volume (CAV) System. |                                                                                                            |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>ENERGY MANAGEMENT SYSTEM</b>                                                                            | <b>9 Periods</b> |
| Concept - Energy Meters: Types, Meter Networking, and Monitoring Energy Parameters - Analysis of Power Quality: Instantaneous Power, Active Power, Reactive Power, and Power Factor - Voltage Current effect of Power Quality on Energy Consumption - Energy Reports - Energy Conservation - Importance of Energy Saving.                                                                                                                                                                                                                                                                                                                                     |                                                                                                            |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>SAFETY SYSTEM</b>                                                                                       | <b>9 Periods</b> |
| Introduction – Fire: Meaning, Fire Development Stages, Fire Sensors & Detectors, Detector Placement, Detectors Required for Various Applications - Fire Extinguishing Principles, Fire Extinguishers and its Classification - Fire Alarm System: Controllers, Components, Features, Concept of Fire Loop and Fire Devices, 2-Wire & 4-Wire Loops, Working Principle, System Description, Pre-alarm and Alarm Troubles and Fault - Cable Selection and Installation Guidelines - Best Installation Practices - NFPA and IS2189 Standards - System Programming.                                                                                                 |                                                                                                            |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>BAS COMMUNICATION STANDARDS AND INTEGRATED SYSTEMS</b>                                                  | <b>9 Periods</b> |
| Building Automation System (BAS) communication standards: Features of BACnet, LonWorks, Modbus, PROFIBUS, EIB - Compatibility of different open protocol standards - Integration at management level - overview of applications of Internet technologies in BAS: Automation level, and Management level. Integration of Systems: Building Management, Energy Management, Safety, Security & Video Management - Benefits of Integrated Systems, Challenges, Future Prospects of Integrated System                                                                                                                                                              |                                                                                                            |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                            |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                            |                  |

**TEXT BOOKS:**

|   |                                                                                                                                                                                                                                                                |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Shengwei Wang, Intelligent Buildings and Building Automation, 2009</i>                                                                                                                                                                                      |
| 2 | <i>Reinhold A. Carlson Robert A. Di Giandomenico, Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lighting, Building, 1<sup>st</sup> edition (R.S. Means Company Ltd), (1991).</i> |

**REFERENCES:**

|   |                                                                               |
|---|-------------------------------------------------------------------------------|
| 1 | <i>Roger W. Haines, "HVAC system Design Handbook", 5<sup>th</sup> edition</i> |
|---|-------------------------------------------------------------------------------|

|   |                                                                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | <i>National Joint Apprenticeship &amp; Training Committee, Building Automation System Integration With Open Protocols: System Integration With Open Protocols</i> |
| 3 | <i>John I. Levenhagen and Donald H. Spethmann, HVAC Controls and Systems (Mechanical Engineering) , 1992.</i>                                                     |
| 4 | <i>James E.Brumbaugh, "HVAC fundamentals", vol: 1 to 3.</i>                                                                                                       |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping                             |                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                      | PO1                                                                                                                      | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                          | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO2                                          | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO3                                          | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO4                                          | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO5                                          | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| <b>22NPES31</b>                              | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| b) CO and Key Performance Indicators mapping |                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                          | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

| ASSESSMENT PATTERN - THEORY                                        |                   |                      |                |                |                   |                 |         |
|--------------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                              | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                               | 10                | 90                   |                |                |                   |                 | 100     |
| CAT2                                                               | 10                | 90                   |                |                |                   |                 | 100     |
| Individual Assessment 1<br>/Case Study 1/<br>Seminar 1 / Project1  |                   | 50                   | 50             |                |                   |                 | 100     |
| Individual Assessment 2<br>/Case Study 2/<br>Seminar 2 / Project 2 |                   | 50                   | 50             |                |                   |                 | 100     |
| ESE                                                                | 10                | 90                   |                |                |                   |                 | 100     |



|          |               |
|----------|---------------|
| 22NPES32 | SMART FARMING |
|----------|---------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                         |                                                                                                          |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                 | To introduce students the important principles, components and practices in the smart farming technology |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                         | <b>INTRODUCTION</b>                                                                                      | <b>9 Periods</b> |  |
| History of Precision farming- Sensing Technology- Control Algorithm- Yield Monitoring- Soil Property Sensing- Acquisition through Remote Sensing- Crop Information- Farmland Data- Spatial Sensing- Temporal Sensing- Feedback Control. |                                                                                                          |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                        | <b>MACHINE LEARNING IN AGRICULTURE</b>                                                                   | <b>9 Periods</b> |  |
| Machine Learning in Agriculture- Deep Learning in Agriculture- Yield prediction- Weed Detection- Irrigation Management - Discrimination between Weed and Crop- Forecasting stages                                                       |                                                                                                          |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                       | <b>IoT IN AGRICULTURE</b>                                                                                | <b>9 Periods</b> |  |
| Need of IoT in Agriculture - Irrigation and Water Quality Management – Monitoring Farm Soil- Aquaponics- Agricultural Machinery- Disease and Pest Control- Challenges and Issues - Protection of Agricultural land from wild animals    |                                                                                                          |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                        | <b>DRONES IN AGRICULTURE</b>                                                                             | <b>9 Periods</b> |  |
| Agricultural Drones: Types of Drones and Classifications – Definitions and Terminologies- Study of Natural Resources and Vegetation- Mapping and Monitoring.                                                                            |                                                                                                          |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                         | <b>AGRICULTURE 5.0</b>                                                                                   | <b>9 Periods</b> |  |
| Introduction to Agriculture 5.0- Remote Sensing- Application of Nanotechnology in Agriculture- Role of Big data- Hurdles faced by Farmers in Adopting- Current Policy Trends and Regulation                                             |                                                                                                          |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                      |                                                                                                          |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                    |                                                                                                          |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                      |
|---|----------------------------------------------------------------------------------------------------------------------|
| 1 | Latief Ahmad, Firasath Nabi, “Agriculture 5.0 – Artificial Intelligence, IoT and Machine learning”, CRC Press, 2021. |
| 2 | Qin Zhang, “Precision Agriculture Technology for Crop Farming”, CRC Press, 2016.                                     |

**REFERENCES:**

|   |                                                                                                                                               |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Govind Singh Patel, “Smart Agriculture”, CRC Press, 2021.                                                                                     |
| 2 | Ajith Abraham, Sujata Dash, Joel J.P.C.Rodrigues, “AI Edge and IoT based smart agriculture”, 2021, Elsevier                                   |
| 3 | Amitava Choudhury, Arindam Biswas, T.P.Singh, Santanu Kumar Ghosh, “Smart Agriculture Automation using Advanced Technologies”, 2021, Springer |

| COURSE OUTCOMES                                             |                                                                                              | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                                              |                         |
| CO1                                                         | Apprehend the fundamentals of precision farming and associated parameter monitoring methods. | K2                      |
| CO2                                                         | Investigate the Machine learning approaches for agriculture                                  | K2                      |
| CO3                                                         | Design and implement IoT in various stages of agriculture.                                   | K4                      |
| CO4                                                         | Analyze the use of drones in agriculture                                                     | K4                      |
| CO5                                                         | Comprehend the underpinning knowledge of Agriculture 5.0                                     | K2                      |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO2                                                 | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO3                                                 | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO4                                                 | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| CO5                                                 | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| <b>22NPE\$32</b>                                    | 2                                                                                                   | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 2    | 2    | 2    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1 1.4.1, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1 1.4.1, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1 1.4.1, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1 1.4.1, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1 1.4.1, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 40             | 10              |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 40             | 10              |                   |                 | 100     |
| ESE                                                          | 10                | 90                   |                |                 |                   |                 | 100     |

|          |                        |
|----------|------------------------|
| 22NPES33 | TRANSDUCER ENGINEERING |
|----------|------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                               |                                                                     |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                       | To provide comprehensive knowledge on various types of transducers. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                               | <b>CHARACTERISTICS OF TRANSDUCERS</b>                               | <b>9 Periods</b> |  |
| Methods of measurement system- Functional blocks of a measurement system – Units and Standards – Classification of errors – Error Analysis – Transducer classification – Static and dynamic characteristics of measurement systems– Selection of Transducers. |                                                                     |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                              | <b>RESISTIVE TRANSDUCERS</b>                                        | <b>9 Periods</b> |  |
| Operating Principle, working of Potentiometers – Metal and semiconductor strain gauges and signal conditioning circuits – Gauge factor –Resistance thermometer - RTD – Thermistor – Hot wire Anemometer –Applications.                                        |                                                                     |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                             | <b>INDUCTANCE AND CAPACITANCE TRANSDUCERS</b>                       | <b>9 Periods</b> |  |
| Operating Principle, working of Self and mutual inductive transducers: LVDT, RVDT, Synchro's - Capacitive transducers -Microphone - Proximity sensors - Applications                                                                                          |                                                                     |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                              | <b>OTHER TRANSDUCERS</b>                                            | <b>9 Periods</b> |  |
| Piezoelectric transducers and their signal conditioning – Magneto strictive transducers - Digital Transducer – Elastic Transducers - Photoelectric transducers – Hall effect sensors – Basics of Gyroscope.                                                   |                                                                     |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                               | <b>ADVANCED TRANSDUCERS</b>                                         | <b>9 Periods</b> |  |
| Seismic transducer and its dynamic response - Fibre optic transducer - Light sensors – Photodiodes, phototransistors - Flow sensors – Ultrasonic sensor - Tactile sensors - Smart sensors - MEMS – Nano Sensors - Electronic Noses and Tongues.               |                                                                     |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                            |                                                                     |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                          |                                                                     |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                  |
|---|----------------------------------------------------------------------------------------------------------------------------------|
| 1 | J. P. Bentley, <i>“Principles of Measurement Systems”</i> , Addison Wesley Longman Ltd., 2010.                                   |
| 2 | Jacob Fraden, <i>“Handbook of Modern Sensors- Physics, Designs, and Applications”</i> , Springer; 4 <sup>th</sup> edition, 2010. |

**REFERENCES:**

|   |                                                                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Shawney A K, <i>“A course in Electrical and Electronic Measurements and Instrumentation”</i> , Dhanpat Rai and Sons. 19 <sup>th</sup> revised edition, 2013. |
| 2 | E. O. Doebelin, <i>“Measurement Systems: Applications and Design”</i> , Tata McGraw-Hill Book Co, 2017.                                                      |
| 3 | D. Patranabis, <i>“Sensors and Transducers”</i> , Prentice Hall India Pvt. Ltd, 2007.                                                                        |
| 4 | S.M. Sze, <i>“Semiconductor sensors”</i> , John Wiley & Sons Inc., 1994.                                                                                     |

| COURSE OUTCOMES                                             |                                                                                                          | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                                                          |                         |
| CO1                                                         | Describe measurement system terminologies and analyze static and dynamic characteristics of transducers. | K3                      |
| CO2                                                         | Elaborate the working and application of various resistive transducers.                                  | K2                      |
| CO3                                                         | Comprehend operating principles and applications of inductive and capacitive transducers.                | K2                      |
| CO4                                                         | Explain the working of transducers, including piezoelectric and magneto strictive                        | K2                      |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                                         |    |
|-----|-------------------------------------------------------------------------|----|
|     | transducers                                                             |    |
| CO5 | Elucidate the operation of modern transducers for diverse applications. | K2 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                              |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                          | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                            | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 1    |
| CO2                                                 | 3                                                                                            | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 1    |
| CO3                                                 | 3                                                                                            | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 1    |
| CO4                                                 | 3                                                                                            | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 1    |
| CO5                                                 | 3                                                                                            | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 1    |
| <b>22NPE\$33</b>                                    | 3                                                                                            | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3    | 1    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                              |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2, 3.1.1, 3.1.2, 3.1.3,3.1.4,3.1.6,4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2, 3.1.1, 3.1.2, 3.1.3,3.1.4,3.1.6,4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2, 3.1.1, 3.1.2, 3.1.3,3.1.4,3.1.6,4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2, 3.1.1, 3.1.2, 3.1.3,3.1.4,3.1.6,4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2, 3.1.1, 3.1.2, 3.1.3,3.1.4,3.1.6,4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 70                   | 10             |                |                   |                 | 100     |
| CAT2                                                         | 30                | 70                   |                |                |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 10                | 80                   | 10             |                |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 80                   |                |                |                   |                 | 100     |
| ESE                                                          | 30                | 70                   |                |                |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                             |
|-----------------|-------------------------------------------------------------|
| <b>22NPES34</b> | <b>PRINCIPLES OF ELECTRICAL AND ELECTRONIC MEASUREMENTS</b> |
|-----------------|-------------------------------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                 |                                                                                            |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                         | To impart knowledge on measurement of various electrical parameters and waveform analysis. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                 | <b>ELECTRICAL MEASUREMENTS</b>                                                             | <b>9 Periods</b> |  |
| General measurement system - Classification of electro mechanical instruments - Principle, working and applications of: Moving coil, Moving iron and Dynamometer type instruments - Extension of instrument range: shunt and multipliers - CT and PT.           |                                                                                            |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                | <b>MEASUREMENT OF POWER &amp; ENERGY</b>                                                   | <b>9 Periods</b> |  |
| Electrodynamic wattmeter - Low power factor (LPF) wattmeter - Errors, Calibration of wattmeter - Single and three phase power measurement - Hall effect wattmeter - Thermal type wattmeter - Single phase induction type energy meter - Phantom loading effect. |                                                                                            |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                               | <b>MEASUREMENT OF R, L, C</b>                                                              | <b>9 Periods</b> |  |
| DC Bridges: Wheatstone Bridge, Modified Wheatstone Bridge, Kelvin Double Bridge - Megger - AC Bridges: Maxwell's Inductance bridge, Hay's bridge, Anderson's bridge, and Schering bridge- Q Meter.                                                              |                                                                                            |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                | <b>DIGITAL MEASUREMENT OF ELECTRICAL QUANTITIES</b>                                        | <b>9 Periods</b> |  |
| Concept of digital measurement - Block diagram of digital voltmeter - Digital multimeter - Digital LCR meter - Digital wattmeter and energy meters.                                                                                                             |                                                                                            |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                 | <b>WAVEFORM ANALYZER</b>                                                                   | <b>9 Periods</b> |  |
| CRO – DSO - Function generator - Waveform analyzers - Spectrum analyzers - Harmonic distortion analyzer.                                                                                                                                                        |                                                                                            |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                              |                                                                                            |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                            |                                                                                            |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Kalsi.H. S, <i>"Electronic Instrumentation"</i> , Tata McGraw Hill Education Private Limited, 3 <sup>rd</sup> Edition, 2012.                                 |
| 2 | Shawney A K, <i>"A course in Electrical and Electronic Measurements and Instrumentation"</i> , Dhanpat Rai and Sons. 19 <sup>th</sup> revised edition, 2013. |

**REFERENCES:**

|   |                                                                                                                                                  |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | David A. Bell, <i>"Electronic Instrumentation and Measurements"</i> , Oxford University Press, 3 <sup>rd</sup> Edition, 2013.                    |
| 2 | Golding, E.W. and Widdis, F.C., <i>"Electrical Measurements and Measuring Instruments"</i> , A.H. Wheeler and Co, 5 <sup>th</sup> Edition, 2011. |
| 3 | Cooper, W.D. and Helfric, A.D., <i>"Electronic Instrumentation and Measurement Techniques"</i> , Prentice Hall, 1 <sup>st</sup> Edition, 2009.   |
| 4 | M B Stout, <i>"Basic Electrical Measurements"</i> , Literary Licensing, LLC, 2012.                                                               |

| <b>COURSE OUTCOMES</b>                                      |                                                                                       | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                       |                                |
| CO1                                                         | Explain the principle of operation of electromechanical instruments.                  | K2                             |
| CO2                                                         | Explain power and energy measurement techniques.                                      | K2                             |
| CO3                                                         | Describe methods for measuring resistance, inductance, and capacitance using bridges. | K3                             |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                                    |    |
|-----|--------------------------------------------------------------------|----|
| CO4 | Measure electrical quantities using digital meters.                | K2 |
| CO5 | Summarize the operation and working of various waveform analyzers. | K2 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                           |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                       | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                         | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | -    |
| CO2                                                 | 2                                                                                         | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | -    |
| CO3                                                 | 2                                                                                         | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | -    |
| CO4                                                 | 2                                                                                         | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | -    |
| CO5                                                 | 2                                                                                         | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | -    |
| <b>22NPE\$34</b>                                    | 2                                                                                         | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | 2    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                           |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1,1.3.1,1.4.1,12.1.2,2.1.3,2.2.1,2.3.2, 2.4.1,2.4.3, 2.4.3, 3.1.1,3.1.2,3.1.4.4.1.2   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1,1.3.1,1.4.1,12.1.2,2.1.3,2.2.1,2.2.3, ,2.3.2, 2.4.1, 2.4.3, 3.1.1,3.1.2,3.1.4.4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1,1.3.1,1.4.1,12.1.2,2.1.3,2.2.1,2.3.2, 2.4.1, 2.4.3, 3.1.1,3.1.2,3.1.4.4.1.2         |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1,1.3.1,1.4.1,12.1.2,2.1.3,2.2.1,2.3.2,2.4.1, 2.4.3, 3.1.1,3.1.2,3.1.4.4.1.2          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1,1.3.1,1.4.1,12.1.2,2.1.3,2.2.1,2.3.2, 2.4.3, 3.1.1,3.1.2,3.1.4.4.1.2                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 70                   | 10             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                | 70                   |                |                 |                   |                 | 100     |
| ESE                                                          | 30                | 60                   | 10             |                 |                   |                 | 100     |

|                 |                              |
|-----------------|------------------------------|
| <b>22NPES35</b> | <b>FIELD INSTRUMENTATION</b> |
|-----------------|------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                               |                                                                                                                                               |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                       | To impart knowledge on field instrumentation encompassing temperature, pressure, level, flow, viscosity, humidity, and moisture measurements. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                               | <b>TEMPERATURE MEASUREMENT</b>                                                                                                                | <b>9 Periods</b> |  |
| Introduction to temperature measurements – Thermocouple – Resistance Temperature Detector – Thermistor and its measuring circuits – Radiation pyrometers and thermal imaging - Temperature IC sensor LM35.                                                                    |                                                                                                                                               |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                              | <b>PRESSURE MEASUREMENT</b>                                                                                                                   | <b>9 Periods</b> |  |
| Introduction - Definition and units, Mechanical, Electro-mechanical pressure measuring instruments – Low and very low pressure measurement - Dead weight tester – I/P and P/I Converters.                                                                                     |                                                                                                                                               |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                             | <b>FLOW MEASUREMENT</b>                                                                                                                       | <b>9 Periods</b> |  |
| Introduction - definition and units - Classification of flow meters: Variable head and variable area flow meters – Positive displacement flow meters – Electromagnetic flow meters – Hot wire anemometer – Ultrasonic flow meters – Calibration and selection of Flow meters. |                                                                                                                                               |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                              | <b>LEVEL MEASUREMENT</b>                                                                                                                      | <b>9 Periods</b> |  |
| Introduction - Mechanical and electrical methods of level measurement: Sight Glass, Float, Displacer, Hydrostatic, Thermal Effect Type– Electrical methods: Resistive and Capacitive Type - Ultrasonic level measurement.                                                     |                                                                                                                                               |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                               | <b>MEASUREMENT OF VISCOSITY, HUMIDITY, MOISTURE</b>                                                                                           | <b>9 Periods</b> |  |
| Viscosity: Saybolt, rotameter and torque type viscometers – Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers - Moisture: Conductivity, Capacitive, Microwave and IR sensor type.                                                          |                                                                                                                                               |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                            |                                                                                                                                               |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                          |                                                                                                                                               |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                        |
|---|----------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Ernest.O. Doebelin and Dhanesh.N. Manik, “Doebelin’s Measurement Systems”, McGraw Hill Education, 6<sup>th</sup> Edition, 2011.</i> |
| 2 | <i>Patranabis D, “Principles of Industrial Instrumentation”, Tata McGraw Hill, 3<sup>rd</sup> Edition, 2010.</i>                       |

**REFERENCES:**

|   |                                                                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>B.G. Liptak, “Process Measurement and Analysis”, CRC Press, 4<sup>th</sup> Edition, 2003</i>                                                          |
| 2 | <i>Douglas M. Considine, “Process / Industrial Instruments &amp; Controls Handbook”, McGraw Hill, Singapore, 5<sup>th</sup> Edition, 1999.</i>           |
| 3 | <i>William C. Dunn, “Fundamentals of Industrial Instrumentation and Process Control”, McGraw Hill Education Pvt. Ltd., 2<sup>nd</sup> Edition, 2018.</i> |
| 4 | <i>S. K. Singh, “Industrial Instrumentation and Control”, Tata Mc Graw Hill Education Pvt. Ltd., 3<sup>rd</sup> Edition, 2009.</i>                       |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                                 | <b>Bloom's Taxonomy Mapped</b> |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------|
| CO1                                                                                   | Describe the working principle, operation and characteristics of temperature measuring devices. | K2                             |
| CO2                                                                                   | Explain the working of various types of pressure measuring techniques.                          | K2                             |
| CO3                                                                                   | Familiarize themselves with the various types of flow measuring instruments.                    | K2                             |
| CO4                                                                                   | Evaluate mechanical and electrical methods for level measurement.                               | K2                             |
| CO5                                                                                   | Illustrate the different methods for measurement of viscosity, humidity, and moisture.          | K2                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                              |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                          | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                            | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| CO2                                                 | 2                                                                                            | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| CO3                                                 | 2                                                                                            | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| CO4                                                 | 2                                                                                            | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| CO5                                                 | 2                                                                                            | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| <b>22NPE\$35</b>                                    | 2                                                                                            | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                              |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.3.2, 2.4.3,3.1.1, 3.1.2,3.1.4, 4.1.2,4.1.4 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.3.2, 2.4.3,3.1.1, 3.1.2,3.1.4, 4.1.2,4.1.4 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.3.2, 2.4.3,3.1.1, 3.1.2,3.1.4, 4.1.2,4.1.4 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.3.2, 2.4.3,3.1.1, 3.1.2,3.1.4, 4.1.2,4.1.4 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.3.2, 2.4.3,3.1.1, 3.1.2,3.1.4, 4.1.2,4.1.4 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                | 70                   |                |                 |                   |                 | 100     |
| ESE                                                          | 30                | 70                   |                |                 |                   |                 | 100     |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                        |
|-----------------|------------------------|
| <b>22NPES36</b> | <b>PROCESS CONTROL</b> |
|-----------------|------------------------|

| <b>PREREQUISITES</b>                  | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---------------------------------------|-----------------|----------|----------|----------|----------|
| <b>22NPES35 FIELD INSTRUMENTATION</b> | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                       |                                                    |                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                               | To impart knowledge on industrial process control. |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                       | <b>INTRODUCTION</b>                                | <b>9 Periods</b> |
| Introduction - Elements of process control loop, concept of process variables: set point, controlled variable, manipulated variables and disturbance variable - Open loop and closed loop control system - Servo and Regulatory control - Block diagram representations of different real world systems.                              |                                                    |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                      | <b>PROCESS MODELLING</b>                           | <b>9 Periods</b> |
| Process modelling: characteristics of liquid systems, gas systems and thermal systems - Degrees of freedom Mathematical model of first order level, pressure and thermal process - higher order process: interacting non-interacting systems.                                                                                         |                                                    |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                     | <b>FINAL CONTROL ELEMENT</b>                       | <b>9 Periods</b> |
| Pneumatic and electrical actuators – Valve positioners – Control valves types- globe, butterfly, diaphragm, ball valves, construction details - Valplug characteristics – Inherent and installed valve characteristics – Selection of control valves - Fail-safe operation – Cavitation and Flashing in control valves.               |                                                    |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                      | <b>CONTROLLER MODES</b>                            | <b>9 Periods</b> |
| Basic control action: Two position, Multi-position, Floating control modes – Continuous controller modes: Proportional, Integral, Derivative – Composite controller modes: P-I, P-D, P-I-D – Response of controllers for different test inputs – Selection of control modes for processes like level, pressure, temperature and flow. |                                                    |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                       | <b>MULTI LOOP CONTROLLERS</b>                      | <b>9 Periods</b> |
| Ziegler Nichols open loop and closed loop method of tuning – Feedback control - Feedforward Control - Feedback plus Feedforward Control - Cascade control - Ratio control. Case study: Boiler drum level control.                                                                                                                     |                                                    |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                    |                                                    |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                  |                                                    |                  |

## TEXT BOOKS:

|   |                                                                                                                                                               |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>G. Stephanopoulos, "Chemical Process Control-An Introduction to Theory and Practice". Prentice Hall of India, New Delhi, 3<sup>rd</sup> Edition,2008..</i> |
| 2 | <i>D.R. Coughanowr, Steven E LeBlanc, "Process Systems Analysis and Control", McGraw Hill, Singapore, 3<sup>rd</sup> Edition,2009</i>                         |

## REFERENCES:

|   |                                                                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>D.E. Seborg, T.E. Edgar, D.A. Mellichamp. "Process Dynamics and Control", Wiley India Pvt. Ltd., 4<sup>th</sup> Edition.2016.</i>                     |
| 2 | <i>B.W. Bequette, "Process Control Modeling, Design and Simulation", Pearson 2<sup>nd</sup> Edition,2023.</i>                                            |
| 3 | <i>C.A. Smith and A.B Corripio., "Principles and Practice of Automatic Process Control", John Wiley and Sons, New York, 3<sup>rd</sup> Edition,2005.</i> |
| 4 | <i>Bela G. Liptak, "Instrument Engineers' Handbook, Volume II: Process Control and Optimization", CRC Press, 4<sup>th</sup> Edition,2005.</i>            |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                              | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Explain the different elements in the process control system.                                | K2                                     |
| CO2                                                                                   | Develop mathematical model for liquid, thermal and gas processes.                            | K3                                     |
| CO3                                                                                   | Evaluate final control elements and select appropriate valves for efficient process control. | K2                                     |
| CO4                                                                                   | Illustrate various controller modes to regulate processes effectively.                       | K2                                     |
| CO5                                                                                   | Elucidate various control methods in process industries                                      | K3                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                      | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                        | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| CO2                                                 | 3                                                                                                        | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| CO3                                                 | 3                                                                                                        | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| CO4                                                 | 3                                                                                                        | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| CO5                                                 | 3                                                                                                        | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| <b>22NPE\$36</b>                                    | 3                                                                                                        | 2   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 1    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3, 2.2.4,3.1.1, 3.1.2 3.1.3,3.1.4,3.1.5,3.1.6, 4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3, 2.2.4,3.1.1, 3.1.2 3.1.3,3.1.4,3.1.5,3.1.6, 4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3, 2.2.4,3.1.1, 3.1.2 3.1.3,3.1.4,3.1.5,3.1.6, 4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3, 2.2.4,3.1.1, 3.1.2 3.1.3,3.1.4,3.1.5,3.1.6, 4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3, 2.2.4,3.1.1, 3.1.2 3.1.3,3.1.4,3.1.5,3.1.6, 4.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                | 50                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                | 50                   | 20             |                 |                   |                 | 100     |
| ESE                                                          | 30                | 70                   |                |                 |                   |                 | 100     |

|                 |                                      |
|-----------------|--------------------------------------|
| <b>22NPES37</b> | <b>INDUSTRIAL AUTOMATION SYSTEMS</b> |
|-----------------|--------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                   |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                             | To provide knowledge on different industrial automation controllers such as DCSs, PLCs, and SCADA |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>INTRODUCTION TO AUTOMATION</b>                                                                 | <b>9 Periods</b> |  |
| Automation overview - Requirements, Architecture and Building blocks of Industrial Automation system - Introduction of Programmable logic Controllers (PLC) and supervisory control and data acquisition (SCADA) - Overview of field devices: Relays - Contactors - Starters - Manually operated switches - Mechanically operated switches - Sensors for field measurements - Solenoid - Solenoid valve - seal-in circuits - Interlocking circuits. |                                                                                                   |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>COMPUTER AIDED MEASUREMENT AND CONTROL</b>                                                     | <b>9 Periods</b> |  |
| Role of computers in measurement and control – Basic components of computer aided measurement and control - Computer based data acquisition system - Industrial bus systems: Modbus & Profibus-Interfacing PC to outside world -Man-machine interface – Internet of things (IoT) for plant automation.                                                                                                                                              |                                                                                                   |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>FUNDAMENTALS OF PLC</b>                                                                        | <b>9 Periods</b> |  |
| Overview of PLC systems – Parts of PLC –Input/output modules – Power supplies and Isolators – Fundamental PLC wiring diagram - Seal-in circuits – Relay logic - PLC Scanning - PLC programming languages.                                                                                                                                                                                                                                           |                                                                                                   |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>PLC PROGRAMMING, SELECTION AND INSTALLATION</b>                                                | <b>9 Periods</b> |  |
| PLC programming languages - Converting Relay Schematics into PLC ladder diagrams - Timers – Counters - Math instructions – Data Manipulation instructions – Sequencer and Shift register instructions - Analog PLC operation – PID Control - PLC Communication and networking - PLC selection - PLC Installation - Advantage and applications of PLC to process control industries.                                                                 |                                                                                                   |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>DISTRIBUTED CONTROL SYSTEM</b>                                                                 | <b>9 Periods</b> |  |
| Overview of DCS - DCS software configuration - DCS communication -DCS Supervisory Computer Tasks - DCS integration with PLC and Computers - Features and Advantages of DCS.                                                                                                                                                                                                                                                                         |                                                                                                   |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                   |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                |                                                                                                   |                  |  |

**TEXT BOOKS:**

|   |                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------|
| 1 | <i>F.D.Petruzella, “Programmable Logic Controllers”, Tata McGraw Hill, 5<sup>th</sup> Edition, 2017.</i> |
| 2 | <i>Krishna Kant, “Computer - Based Industrial Control”, Prentice Hall, 2<sup>nd</sup> Edition, 2011.</i> |

**REFERENCES:**

|   |                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Bela.G.Liptak, “Process Software and Digital Networks – Volume 3”, CRC Press, 4<sup>th</sup> Edition, 2012</i>                                     |
| 2 | <i>G.Clarke, D.Reynders and E.Wright, “Practical Modern SCADA Protocols:DNP3, 60870.5 and Related Systems”, Newnes, 1<sup>st</sup> Edition, 2004.</i> |
| 3 | <i>IDC Technologies, “Practical Distributed Control Systems (DCS) for Engineers and Technicians” 2012.</i>                                            |
| 4 | <i>M.P.Lukas, “Distributed Control Systems”, Van Nostrand Reinhold Co, 1<sup>st</sup> Edition, 1986.</i>                                              |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                               | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Elaborate the building blocks of automation systems and various field devices | K2                                     |
| CO2                                                                                   | Describe the role of computer aided measurements and data acquisition systems | K2                                     |
| CO3                                                                                   | Explain the architecture and various modules of PLC                           | K2                                     |
| CO4                                                                                   | Develop ladder program for a given sequential operation                       | K3                                     |
| CO5                                                                                   | Explain the architecture of DCS and its integration with PLC and computers    | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                         |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                       | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 1    | 3    |
| CO2                                                 | 3                                                                                                       | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 1    | 3    |
| CO3                                                 | 3                                                                                                       | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 1    | 3    |
| CO4                                                 | 3                                                                                                       | 2   | 1   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    | 1    | 3    |
| CO5                                                 | 3                                                                                                       | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 1    | 3    |
| <b>22NPES37</b>                                     | 3                                                                                                       | 2   | 1   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | 1    | 1    | 3    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                         |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6, 5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.6        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                | 80                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 40                   | 40             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 40                   | 40             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 40                   | 40             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 60                   | 20             |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                |
|-----------------|--------------------------------|
| <b>22NPES38</b> | <b>VIRTUAL INSTRUMENTATION</b> |
|-----------------|--------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>2</b> | <b>0</b> | <b>2</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                       |                                                                                                     |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                               | To impart knowledge on the concept of Virtual instrumentation, software tools, and data acquisition |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                       | <b>INTRODUCTION</b>                                                                                 | <b>6 Periods</b> |  |
| Graphical System Design Model - Virtual Instrumentation Model - Design Flow with Graphical System Design - Virtual Instruments and Traditional Instruments - Hardware and Software in Virtual Instrumentation - Virtual Instrumentation for Test, Control and Design - Graphical Programming and Textual Programming. |                                                                                                     |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                      | <b>LabVIEW ENVIRONMENT</b>                                                                          | <b>6 Periods</b> |  |
| Front Panel - Block Diagram - Icon and Connector - Control Palette - Function Palette-Tools Palette - Creating, Editing, Wiring, Debugging and Saving VIs - Sub VIs - Creating Sub VIs - Simple Examples                                                                                                              |                                                                                                     |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                     | <b>PROGRAMMING TECHNIQUES</b>                                                                       | <b>6 Periods</b> |  |
| Repetition and Loops - Arrays - Clusters - Structures - Strings -Plotting Data - File I/O                                                                                                                                                                                                                             |                                                                                                     |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                      | <b>DATA ACQUISITION</b>                                                                             | <b>6 Periods</b> |  |
| Signal Conditioning - DAQ Hardware - DAQ Hardware Configuration – Analog I/O - Digital I/O-Counter - Timer - DAQ Software Architecture - Network Data Acquisition                                                                                                                                                     |                                                                                                     |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                       | <b>APPLICATIONS IN VARIOUS DOMAINS</b>                                                              | <b>6 Periods</b> |  |
| Application in various domains: Control Design, Process Control, Biomedical, Image Acquisition and Processing.                                                                                                                                                                                                        |                                                                                                     |                  |  |
| <b>LIST OF EXPERIMENTS</b>                                                                                                                                                                                                                                                                                            |                                                                                                     |                  |  |
| Simple Exercise with VI .                                                                                                                                                                                                                                                                                             |                                                                                                     |                  |  |
| Converting a VI into a Sub VI.                                                                                                                                                                                                                                                                                        |                                                                                                     |                  |  |
| Programming using FOR and WHILE Loops                                                                                                                                                                                                                                                                                 |                                                                                                     |                  |  |
| Programming using Structure, Arrays, and Clusters                                                                                                                                                                                                                                                                     |                                                                                                     |                  |  |
| Strain and Temperature Measurement with NI Elvis                                                                                                                                                                                                                                                                      |                                                                                                     |                  |  |
| Frequency Analysis of Signal Using NI-DAQmx,                                                                                                                                                                                                                                                                          |                                                                                                     |                  |  |
| Stepper Motor Control using LabVIEW                                                                                                                                                                                                                                                                                   |                                                                                                     |                  |  |
| <b>Contact Periods: 60 Periods</b>                                                                                                                                                                                                                                                                                    |                                                                                                     |                  |  |
| <b>Lecture: 30 Periods      Tutorial: 0 Periods      Practical: 30 Periods      Total: 60 Periods</b>                                                                                                                                                                                                                 |                                                                                                     |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                         |
|---|-------------------------------------------------------------------------------------------------------------------------|
| 1 | Jovitha Jerome, " <i>Virtual Instrumentation Using LabVIEW</i> ", PHI Learning Pvt. Ltd, 1 <sup>st</sup> Edition, 2010. |
| 2 | Gary Johnson, Richard Jennings, " <i>Lab view graphical programming</i> ", Tata McGraw Hill, 2011.                      |

**REFERENCES:**

|   |                                                                                                                                                |
|---|------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Sanjay Gupta and Joseph John, " <i>Virtual Instrumentation using LabVIEW</i> ", Tata McGrawHill, 2 <sup>nd</sup> Edition, 2010.                |
| 2 | Kevin James, " <i>PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control</i> ", Newnes Publishers, 2000. |
| 3 | Mathivanan, N., " <i>PC-Based Instrumentation</i> ", PHI Learning Pvt. Ltd, New Delhi, 2009.                                                   |
| 4 | Lisa K Wells and Jeffrey Travels, " <i>Labview for everyone</i> ", Prentice Hall, 3 <sup>rd</sup> Edition 2009.                                |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                               | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Differentiate graphical programming from textual programming                  | K2                                     |
| CO2                                                                                   | Program using LABVIEW software                                                | K3                                     |
| CO3                                                                                   | Plot responses and analyze data                                               | K3                                     |
| CO4                                                                                   | Acquire data from sensors using DAQ                                           | K3                                     |
| CO5                                                                                   | Use different tools available in LABVIEW based on the application requirement | K3                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                             |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-----------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                         | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                           | 1   | 1   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| CO2                                                 | 2                                                                           | 1   | 1   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| CO3                                                 | 2                                                                           | 1   | 1   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| CO4                                                 | 2                                                                           | 1   | 1   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| CO5                                                 | 2                                                                           | 1   | 1   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| <b>22NPE\$38</b>                                    | 2                                                                           | 1   | 1   | -   | 3   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                             |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1, 1.3.1, 2.1.2, 2.2.4, 3.2.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1, 1.3.1, 2.1.2, 2.2.4, 3.2.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1, 1.3.1, 2.1.2, 2.2.4, 3.2.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1, 1.3.1, 2.1.2, 2.2.4, 3.2.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1, 1.3.1, 2.1.2, 2.2.4, 3.2.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 40                | 40                   | 20             |                |                   |                 | 100     |
| CAT2                                                         |                   | 50                   | 50             |                |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 30                   | 70             |                |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 30                   | 70             |                |                   |                 | 100     |
| ESE                                                          | 20                | 40                   | 40             |                |                   |                 | 100     |

|                 |                                   |
|-----------------|-----------------------------------|
| <b>22NPES39</b> | <b>ANALYTICAL INSTRUMENTATION</b> |
|-----------------|-----------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                               |                                                                                                                      |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                       | To impart the knowledge on the working principles of different types of analytical instruments used in the industry. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                               | <b>SPECTROPHOTOMETRY</b>                                                                                             | <b>9 Periods</b> |  |
| Spectral methods of analysis – Beer-Lambert law – Sources, Detectors, Construction, Working and Applications : UV and Visible spectroscopy, IR Spectrophotometer, FTIR spectrophotometer, Atomic absorption spectrophotometer, Flame emission and atomic emission photometry.                 |                                                                                                                      |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                              | <b>CHROMATOGRAPHY</b>                                                                                                | <b>9 Periods</b> |  |
| General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography –Applications.                                                                                      |                                                                                                                      |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                             | <b>INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS</b>                                                 | <b>9 Periods</b> |  |
| Gas analyzers : Oxygen, NO <sub>2</sub> and H <sub>2</sub> S types- IR analyzers - thermal conductivity detectors- analysis based on ionization of gases. Measurement of air pollution due to: carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide - Dust and smoke measurements. |                                                                                                                      |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                              | <b>pH METERS AND DISSOLVED COMPONENT ANALYZERS</b>                                                                   | <b>9 Periods</b> |  |
| Selective ion electrodes - Principle of pH and conductivity measurements - dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.                                                                                                                           |                                                                                                                      |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                               | <b>NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY</b>                                                              | <b>9 Periods</b> |  |
| NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.                                                                                                     |                                                                                                                      |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                            |                                                                                                                      |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                          |                                                                                                                      |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A, " <b>Instrumental methods of analysis</b> ", 7 <sup>th</sup> Edition, 2012.. |
| 2 | Khandpur. R.S, " <b>Handbook of Analytical Instruments</b> ", Tata McGraw-Hill publishing Co.Ltd., 2 <sup>nd</sup> Edition 2007.    |

**REFERENCES:**

|   |                                                                                                                                           |
|---|-------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Liptak.B.G, " <b>Process Measurement and Analysis</b> ", CRC Press, 5 <sup>th</sup> Edition, 2015.                                        |
| 2 | Ewing, G.W, " <b>Instrumental Methods of Chemical Analysis</b> ", McGraw-Hill, 5 <sup>th</sup> Edition Reprint 1985. (Digitized in 2007). |
| 3 | Braun. R.D, " <b>Introduction to Instrumental Analysis</b> ", Pharma Book Syndicate, 2006.                                                |
| 4 | Braun, R.D., " <b>Introduction to Instrumental Analysis</b> ", Pharma Book Syndicate, 2 <sup>nd</sup> Edition 2016.                       |

| <b>COURSE OUTCOMES</b>                                      |                                                                              | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                              |                                |
| CO1                                                         | Explain the working principle and types of spectroscopy.                     | K2                             |
| CO2                                                         | Describe the operation and classification of chromatographic techniques.     | K2                             |
| CO3                                                         | Elaborate the operation of industrial gas analyzers and pollution monitoring | K2                             |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                                            |    |
|-----|----------------------------------------------------------------------------|----|
|     | instruments                                                                |    |
| CO4 | Enunciate the working of pH meters and dissolved component analyzers       | K2 |
| CO5 | Express the operation of Nuclear Magnetic Resonance and Mass spectrometry. | K2 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|----------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                            | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                              | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| CO2                                                 | 3                                                              | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| CO3                                                 | 3                                                              | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| CO4                                                 | 3                                                              | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| CO5                                                 | 3                                                              | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| <b>22NPE\$39</b>                                    | 3                                                              | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1,.1.1.2, 1.2,1, 1.2.,2, 2.1.1,2.1.2, 3.1.1, 3.1.6, 3.3.1. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1,.1.1.2, 1.2,1, 1.2.,2, 2.1.1,2.1.2, 3.1.1, 3.1.6, 3.3.1. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1,.1.1.2, 1.2,1, 1.2.,2, 2.1.1,2.1.2, 3.1.1, 3.1.6, 3.3.1. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1,.1.1.2, 1.2,1, 1.2.,2, 2.1.1,2.1.2, 3.1.1, 3.1.6, 3.3.1. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1,.1.1.2, 1.2,1, 1.2.,2, 2.1.1,2.1.2, 3.1.1, 3.1.6, 3.3.1. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 80                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 80                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 80                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 80                   |                |                 |                   |                 | 100     |
| ESE                                                          | 20                | 80                   |                |                 |                   |                 | 100     |

|                 |                                   |
|-----------------|-----------------------------------|
| <b>22NPES40</b> | <b>REAL TIME EMBEDDED SYSTEMS</b> |
|-----------------|-----------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                     |                  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | To elaborate the basic concepts of embedded systems and real time operating systems |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>INTRODUCTION TO EMBEDDED SYSTEMS</b>                                             | <b>9 Periods</b> |  |
| Structural Units in Embedded Processor - Selection of Processor and Memory Devices - DMA – Memory Mapping - Timer and Counting Devices - Watchdog Timer - Real Time Clock - Software Embedded in a system - IDE - Assembler - Compiler - Linker - Simulator - Debugger - In-Circuit Emulator - Target Hardware Debugging - Boundary Scan                                                                                                                                                                                                             |                                                                                     |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>PROCESSOR HARDWARE</b>                                                           | <b>9 Periods</b> |  |
| Internal Processor Design: ALU – Registers - Control Unit - Clock – On-Chip Memory - Cache – Processor I/O – Interrupts – Processor Buses – Processor Performance- Powering the Hardware - Embedded Board using Von-Neumann Model. Embedded Processors: ISA Architecture Models – Application Specific ISA Models – General Purpose ISA Models – Instruction Level Parallelism.                                                                                                                                                                      |                                                                                     |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>EMBEDDED PROGRAMMING</b>                                                         | <b>9 Periods</b> |  |
| C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization – In-line Assembly. Device driver- Boot loader – I/O Busy Wait Approach without Interrupt Service Mechanism                                                                                                                                                       |                                                                                     |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>ARM ARCHITECTURE AND PERIPHERALS</b>                                             | <b>9 Periods</b> |  |
| Introduction to ARM – Architecture – <b>LPC2148 / LPC4088</b> / CortexA53 – Memory Organization – Addressing Modes - Interrupt Structure. Peripherals: I/O Ports - I/O Memory – EEPROM – SRAM – Timer – Serial Communication – <b>I2C / SPI / UART</b> - ADC and/ DAC Interfacing – Wireless – Bluetooth / <b>Zigbee / LoRaWAN</b>                                                                                                                                                                                                                   |                                                                                     |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>REAL TIME OPERATING SYSTEMS</b>                                                  | <b>9 Periods</b> |  |
| Basic Principles - Operating System Structures – Interrupt Handling - Kernel and Subsystem – Kernel Space and User Space – System Calls – Files – Types of RTOS – Functions of RTOS; Task and Task State – Processes and Threads – Inter Process Communication - Message Queues – Mailboxes - Pipes – Process Synchronization - Critical Section – Mutex / Semaphores - Multitask – Context Switching - Schedulers: – FCFS, SJF, Priority Scheduler, Round Robin, Multithreaded Preemptive Scheduler. Classical Synchronization Problems – Deadlocks |                                                                                     |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                     |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                     |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------|
| 1 | Rajkamal, “ <i>Embedded Systems Architecture, Programming and Design</i> ”, Tata McGraw Hill, 3 <sup>rd</sup> Edition, 2017. |
| 2 | Rajib Mall, “ <i>Real-Time systems Theory and Practice</i> ”, Pearson Education, 2007                                        |

**REFERENCES:**

|   |                                                                                                                                                        |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Jonathan W. Valvano, “ <i>Introduction to ARM Cortex Microcontroller</i> ”, Createspace Independent Publishing Platform, 5 <sup>th</sup> Edition 2017. |
| 2 | Silberschatz, Galvin, Gagne, “ <i>Operating System Concepts</i> ”, John Wiley, 9 <sup>th</sup> Edition, 2013.                                          |
| 3 | Jean J. Labrosse, “ <i>Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C</i> ”, CRC Press, 2019.                                |
| 4 | Jonathan W. Valvano, “ <i>Embedded Microcomputer Systems, Real Time Interfacing</i> ”, Cengage Learning, 3 <sup>rd</sup> , 2011.                       |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                      | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Outline the concepts of embedded systems                             | K2                                     |
| CO2                                                                                   | Explain the operation of basic hardware involved in embedded systems | K2                                     |
| CO3                                                                                   | Program using embedded C programming                                 | K3                                     |
| CO4                                                                                   | Describe ARM architecture, and its memory organization               | K2                                     |
| CO5                                                                                   | Elaborate the basic concepts of real-time operating systems          | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                              |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                                          | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                                                                            | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | 3    | -    | -    |
| CO2                                                 | 2                                                                                                                                            | 1   | -   | -   | -   | -   | -   | -   | -   | -    | -    | 1    | 3    | -    | -    |
| CO3                                                 | 2                                                                                                                                            | 3   | 1   | -   | 2   | -   | -   | -   | -   | -    | -    | 1    | 3    | -    | 2    |
| CO4                                                 | 2                                                                                                                                            | 2   | 1   | -   | 2   | -   | -   | -   | -   | -    | -    | 1    | 3    | -    | 2    |
| CO5                                                 | 2                                                                                                                                            | 2   | 1   | -   | 2   | -   | -   | -   | -   | -    | -    | 1    | 3    | -    | 2    |
| <b>22NPES40</b>                                     | 2                                                                                                                                            | 2   | 1   | -   | 2   | -   | -   | -   | -   | -    | -    | 1    | 3    | -    | 2    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                              |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.3.1, 1.4.1, 2.1.3, 2.2.4, 2.3.1, 2.4.1, 12.1.2, 12.2.2                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.3.1, 1.4.1, 2.1.3, 2.2.4, 2.3.1, 2.4.1, 12.1.2, 12.2.2                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.2, 2.4.1, 2.4.2, 2.4.3, 3.1.6, 3.2.1, 3.2.2, 5.1.1, 5.2.1, 5.3.1, 12.1.2, 12.2.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.3.1, 1.4.1, 2.1.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 3.2.1, 3.2.2, 5.1.1, 5.2.1, 5.3.1, 12.1.2, 12.2.2                                           |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.3.1, 1.4.1, 2.1.3, 2.2.1, 2.2.4, 2.3.1, 2.4.1, 3.2.1, 3.2.2, 5.1.1, 5.2.1, 5.3.1, 12.1.2, 12.2.2                                           |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 40                | 60                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 50             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 50             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 60                   | 20             |                 |                   |                 | 100     |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                         |
|-----------------|-------------------------------------------------------------------------|
| <b>22NPES41</b> | <b>ELECTRONIC CIRCUIT DESIGN</b><br>(Common to EEE, ECE & EIE Branches) |
|-----------------|-------------------------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PE       | 3 | 0 | 0 | 3 |

|                         |                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>COURSE OBJECTIVE</b> | 1. To provide in-depth knowledge of the electronic circuit design from power supplies to SoCs including the connectivity solutions and to provide the knowledge on the nuances of electronic product design<br>2. Emphasis the practical aspects of circuit design and analysis<br>3. To impart the knowledge of circuits analysis for their static and dynamic behaviour through Simulation |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                 |                                                                  |                  |
|-----------------|------------------------------------------------------------------|------------------|
| <b>UNIT - I</b> | <b>INTRODUCTION TO SENSORS, POWER SUPPLY, SWITCH AND DRIVERS</b> | <b>9 Periods</b> |
|-----------------|------------------------------------------------------------------|------------------|

Introduction: Sensors - Connectivity Solutions - AI/ML - HW requirements - Design Challenges.  
Non-ideal behavior of Components – Resistors, Capacitors; Inductors; Ferrite Beads; Fundamentals of BJT, MOSFET and IGBT gate driver circuits - Effect of Impedance mismatch and Signal Quality. Linear and Switching regulators- Buck and Boost Converters - Stability, Performance, Dynamic Behavior - EMI Filters - high-side and low-side switches - H-bridge - Current Sensing Techniques.

|                  |                                           |                  |
|------------------|-------------------------------------------|------------------|
| <b>UNIT - II</b> | <b>DATA CONVERTERS AND I/O INTERFACES</b> | <b>9 Periods</b> |
|------------------|-------------------------------------------|------------------|

Digital IOs; PWM, Frequency Inputs; Data conversion; Quantization; Reference Voltages; Sampling Time; Resolution; ADC Errors – Non-linearity; Offset; Gain; Noise - Dynamic Range – ENOB - Parasitic capacitance - Channel cross-talk - ADC/DAC interface.

|                   |                       |                  |
|-------------------|-----------------------|------------------|
| <b>UNIT - III</b> | <b>SYSTEM ON CHIP</b> | <b>9 Periods</b> |
|-------------------|-----------------------|------------------|

Need for SoC - Components of a SoC - Heterogeneous processing cores : microprocessors, DSPs, hardware processing engines like audio, video, accelerators, memories, and I/O interfaces - System level On-chip Communication Architectures – Bus and NoC based, Application Specific Hardware Accelerators – GPU, Neural, MMA - device management, memory hierarchy, and data movement, virtualization - security, and power - Challenges and optimization of Interconnects, Partitioning and Mapping of a software function to hardware - Power/Performance/Area Trade Offs vs Reliability - Safety and Security Features - Interfaces – External Memory, I/O, ADC/DAC, UART, CAN, Ethernet, USB, MIPI; Insight into SoC Design Process (from RTL to Chip, Requirements and Design Iteration) - Dealing with Design Complexity (Buying IP and Reconfiguration).

|                  |                                       |                  |
|------------------|---------------------------------------|------------------|
| <b>UNIT - IV</b> | <b>PMICs AND WIRED COMMUNICATIONS</b> | <b>9 Periods</b> |
|------------------|---------------------------------------|------------------|

Need for PMIC – On Chip Power Management, State Machine, Compensation Techniques - Voltage and Frequency Scaling - Applications; Examples – PF8101 (NXP), TPS659119-Q1 (TI), MAX20430 (Maxim) - Input and Output Supply Ranges - Power Sequence – Supervisory - Watchdog Operation. High Speed Links – Transmitter, Channel, Receiver - Common Mode Rejection – Serializer, De-Serializer - Controller Area Networks (CAN) - Ethernet (Automotive)- Universal Serial Bus (USB) - Camera Interfaces (FPD or GMSL) - Power over Data Link (PoDL).

|                 |                                |                  |
|-----------------|--------------------------------|------------------|
| <b>UNIT - V</b> | <b>WIRELESS COMMUNICATIONS</b> | <b>9 Periods</b> |
|-----------------|--------------------------------|------------------|

Fundamentals of RF-Transmission Lines, Resonators, Antennas, Wave Propagation, Transmitters, Receivers - Digital Modulation Techniques - Channel Impairments - MIMO; WLAN; Bluetooth; Cellular – LTE/5G - Navigation Systems - Identification Systems-NFC, RFID; UWB.

**Contact Periods: 45 Periods**

**Lecture: 45 Periods    Tutorial: 0 Periods    Practical: 0 Periods    Total: 45 Periods**

## TEXT BOOKS:

|   |                                                                                   |
|---|-----------------------------------------------------------------------------------|
| 1 | Ke-Horng Chen, “Power Management for Integrated Circuit Design”, Wiley, 2016      |
| 2 | Michael.J. Flynn and Wayne Luk, “Computer System Design: System-On-Chip, Hoboken, |

|   |                                                                                         |
|---|-----------------------------------------------------------------------------------------|
|   | <i>New Jersey”, Wiley, 2011</i>                                                         |
| 3 | <i>G. Manganaro, “Advanced Data Converters. Cambridge”, Cambridge Univ. Press, 2012</i> |

|   |                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>W. A. Kester, “Data Conversion Handbook”, Amsterdam, Elsevier Newnes, 2005</i>                                                                   |
| 2 | <i>Beuchat R D, et.al, “Fundamentals of System-on-Chip Design on Arm Cortex-M Microcontrollers, Arm Education Media”, Arm Education Media, 2021</i> |
| 3 | <i>Joseph Yiu, “System-on-Chip Design with Arm Cortex-M Processors”, Reference Book, Cambridge, ARM Education Media, 2019</i>                       |
| 4 | <i>Mona M. Hella, and Patrick Mercier, Eds., “Power management integrated circuits”, CRC Press, 2016</i>                                            |
| 5 | <i>Forouzan B A, “Data Communications and Networking”, McGraw-Hill, 5th ed. India, 2017</i>                                                         |
| 6 | <i>Qizheng GU, “RF System Design of Transceivers for Wireless Communications”, Springer, 2015</i>                                                   |
| 7 | <i>Maniktala S, “Power over ethernet interoperability”, McGraw-Hill, New York, 2013.</i>                                                            |

in the system on chip  
Additional blocks for PM  
communication technologies



| a) CO/PO Mapping                             |                                                                                                                                                                                                              |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                      | PO1                                                                                                                                                                                                          | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                          | 3                                                                                                                                                                                                            | 2   | 2   | 1   | 1   | 2   | 2   | 1   | -   | -    | 1    | 1    | 3    | 1    | 1    |
| CO2                                          | 2                                                                                                                                                                                                            | 2   | 1   | 2   | 1   | -   | -   | -   | -   | -    | -    | 2    | 3    | 1    | 1    |
| CO3                                          | 2                                                                                                                                                                                                            | 2   | 1   | -   | 1   | -   | -   | -   | -   | -    | 1    | 2    | 3    | 1    | 1    |
| CO4                                          | 3                                                                                                                                                                                                            | 2   | 2   | 1   | 1   | 2   | 2   | 1   | -   | -    | 1    | 1    | 3    | 1    | 1    |
| CO5                                          | 3                                                                                                                                                                                                            | 2   | 2   | 1   | 1   | 2   | 2   | 1   | -   | -    | 1    | 1    | 3    | 1    | 1    |
| <b>22NPES41</b>                              | 3                                                                                                                                                                                                            | 2   | 1   | 1   | 1   | 2   | 2   | 1   | -   | -    | 1    | 2    | 3    | 1    | 1    |
| b) CO and Key Performance Indicators mapping |                                                                                                                                                                                                              |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                          | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 3.1.3, 3.1.4, 3.1.6, 3.2.1, 3.2.2, 3.4.2, 4.1.2, 4.1.3, 5.1.1, 5.2.1, 6.2.1, 7.1.1, 7.1.2, 8.2.1, 11.1.1, 12.1.1, 12.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.2.4, 2.3.1, 2.4.3, 3.1.4, 3.1.6, 3.2.3, 3.3.1, 4.1.2, 4.1.3, 4.1.4, 5.1.1, 12.1.1, 12.1.2, 12.2.2, 12.3.2                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.2.4, 2.3.1, 2.3.2, 3.1.4, 3.1.6, 5.1.1, 5.2.1, 11.1.1, 12.1.1, 12.1.2, 12.2.2                                                                                           |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                          | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 3.1.3, 3.1.4, 3.1.6, 3.2.1, 3.2.2, 3.4.2, 4.1.2, 4.1.3, 5.1.1, 5.2.1, 6.2.1, 7.1.1, 7.1.2, 8.2.1, 11.1.1, 12.1.1, 12.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                          | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 3.1.3, 3.1.4, 3.1.6, 3.2.1, 3.2.2, 3.4.2, 4.1.2, 4.1.3, 5.1.1, 5.2.1, 6.2.1, 7.1.1, 7.1.2, 8.2.1, 11.1.1, 12.1.1, 12.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

| ASSESSMENT PATTERN - THEORY                                           |                   |                      |                |                |                   |                 |         |
|-----------------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                                 | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                                  | 20                | 40                   | 40             |                |                   |                 | 100     |
| CAT2                                                                  | 10                | 40                   | 50             |                |                   |                 | 100     |
| Individual Assessment 1<br>/Case Study<br>1/ Seminar 1<br>/ Project1  |                   | 30                   | 40             | 30             |                   |                 | 100     |
| Individual Assessment 2<br>/Case Study<br>2/ Seminar 2<br>/ Project 2 |                   | 40                   | 40             | 20             |                   |                 | 100     |
| ESE                                                                   | 20                | 40                   | 40             |                |                   |                 | 100     |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                                           |
|-----------------|-------------------------------------------------------------------------------------------|
| <b>22NPES42</b> | <b>ELECTRONIC SYSTEM DESIGN AND PRODUCTIZATION</b><br>(Common to EEE, ECE & EIE Branches) |
|-----------------|-------------------------------------------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | PE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                         |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | To introduce broad knowledge for the design, development, fabrication of electronic products, printed circuit boards and systems and its reliability and product safety |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>PCB DESIGN, RULES, AND MANUFACTURABILITY</b>                                                                                                                         | <b>9 Periods</b> |  |
| PCB Technology – Component Packaging, Layer Stackup, Via Technology, HDI Concept; PCB Materials – Grades and Specification, example - FR4, Weaving Concept, Low Loss & High Performance Materials, Mechanical and Thermal Properties; Layer Stackup – Copper Foil, Pre-pegs and Base Material (Core), Dimensional Stability, CAF Growth; PCB Design Process – Influence from Package types, Material Choices, Fabrication Methods, Lead-free Assembly; Current Capacity; Thermal Signatures, File Format, Rule Checks – ERC and DRC, Power, Ground, and Signal Trace Consideration; Choice of CAD tools; IPC Standards for PCB – Introduction.                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                         |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>ELECTROMAGNETIC COMPATIBILITY AND COMPLIANCE</b>                                                                                                                     | <b>9 Periods</b> |  |
| Introduction – History of Accidents, Impact of Technology Evolution, Importance of EMC and Regulations; EMC Concepts – Conducted, Radiated, Emissions, Susceptibility/Immunity; EMC Control Methods – Impedance Matching, Resonances, Balancing, Filtering, ESD Protection, Shielding, Grounding; PCB Design; Enclosure Design; EMC Prediction using Simulations; EMC Compliance – CISPR Test Setups, IEC Test Standards; Government Regulatory Requirements – FCC, RED, UNCECR10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                         |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>THERMAL MANAGEMENT FOR ELECTRONICS</b>                                                                                                                               | <b>9 Periods</b> |  |
| Introduction, Heat Transfer Theory; Concept of thermal resistance; Use of datasheets; Passive and Active Cooling – Forced Air, Liquid, Thermo Electric Cooling; Aspects of Heat Sink Design; Thermal Modeling and Measurement – CFD; Heat Management in Automotive Applications.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                         |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>DESIGN FOR RELIABILITY AND MANUFACTURING</b>                                                                                                                         | <b>9 Periods</b> |  |
| Basic Concepts – Quality and Reliability Assurance; Analysis during the Design Phase; Qualification tests for Components and Assemblies; Design guidelines for Reliability and Maintainability; Statistical Quality Control and Reliability Tests; Check lists for Design Reviews; Design FMEA/DRBFM; MTBF Calculation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                         |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>PRODUCT SAFETY, SECURITY, COMPLIANCE AND CERTIFICATION</b>                                                                                                           | <b>9 Periods</b> |  |
| Need for Product Safety; Examples – Automotive; CE/ISO/IEC/BIS; Safety Education: Products-Hazards-Age; Voltage Faults – Surge, Ringing, Polarity reversal, Current fault – short circuit, Inrush, Reverse; Thermal – Over temperature, thermal protection; Battery Safety Standards; Product Construction Requirements; Resistance to Fire and Flame Rating; Human Factors – Ergonomic Hazards; Safety Instructions - Cautions and Warnings.<br>Regulatory compliance – Product Specific - EMC, Safety, and RF; Substance Regulation – RoHS, WEEE, REACH etc; Labeling, Documentation, Marking, Packaging and Testing; Industry Compliance – Industry specific; Technical documentation; EU declaration of conformity; Regional (states, districts) Specific compliance – data security and material; Usage Instructions; Traceability; IATF 16949; ISO 9000; ISO140000; ASPICE; GDPR.<br>Process of Certification : ISO/IEC 17065 Conformity Assessment; ISO 17011; Certifying Bodies; Standards; Marking/Certificate; Accreditation Bodies; IAF, FCC, CE, BIS, NABL. |                                                                                                                                                                         |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                         |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                         |                  |  |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

**TEXT BOOKS:**

|   |                                                                                                                            |
|---|----------------------------------------------------------------------------------------------------------------------------|
| 1 | Clyde F. Coombs and Happy Holden , “ <b>Printed Circuits Handbook</b> ”, 7 <sup>th</sup> Edition, McGraw Hill, 2016        |
| 2 | Clayton R. Paul, “ <b>Introduction to Electromagnetic Compatibility</b> ”, Wiley , 2 <sup>nd</sup> Edition, 2010;          |
| 3 | T. Yomi Obidi, “ <b>Thermal Management in Automotive Applications</b> ”, SAE International, 1 <sup>st</sup> Edition, 2015. |

### REFERENCES:

|   |                                                                                                                          |
|---|--------------------------------------------------------------------------------------------------------------------------|
| 1 | Wilson, P, " <b>The Circuit Designer's Companion</b> ", Oxford Newnes, 3 <sup>rd</sup> Edition, 2011                     |
| 2 | Terence Rybak and Mark Stefafika, " <b>Automotive EMC</b> ", Kluwer Academic Publishers, 1 <sup>st</sup> Edition, 2003.  |
| 3 | Ralph Remsburg, " <b>Thermal Design of Electronic Equipment</b> ", CRC Press, 1 <sup>st</sup> Edition, 2001              |
| 4 | Alessandro Birolini, " <b>Reliability Engineering: Theory and Practice</b> ", Springer, 8 <sup>th</sup> Edition, 2017.   |
| 5 | Jan Swart, " <b>Electrical Product Compliance and Safety Engineering</b> ", Artech House, 1 <sup>st</sup> Edition, 2017. |
| 6 | J. Doherty, " <b>Wireless and Mobile Device Security</b> ", Jones and Bartlett Learning, 2 <sup>nd</sup> Edition, 2021.  |

| COURSE OUTCOMES                                             |                                                                                                                             | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                                                                             |                         |
| CO1                                                         | Elaborate the PCB design process and the manufacturability requirements                                                     | K2                      |
| CO2                                                         | Enunciate the electromagnetic compatibility required for a product and its standards                                        | K3                      |
| CO3                                                         | Outline the thermal management strategies required for automotive applications                                              | K2                      |
| CO4                                                         | Analyze a design for its failure modes; and design a reliable, safe product and compute its failure rate or MTBF            | K4                      |
| CO5                                                         | Identify and fulfill all requirements for the product compliance and certification considering EMC, RF, safety and security | K3                      |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping |     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs          | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1              | 3   | 3   | 2   | -   | 1   | 2   | 1   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO2              | 3   | 3   | 2   | -   | 1   | 2   | 1   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO3              | 3   | 3   | 2   | -   | 1   | 2   | 1   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO4              | 3   | 3   | 2   | 2   | 1   | 2   | 1   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| CO5              | 3   | 3   | 2   | 2   | 1   | 2   | 1   | -   | -   | -    | -    | -    | 2    | 1    | 1    |
| 22NPES42         | 3   | 3   | 2   | 1   | 1   | 2   | 1   | -   | -   | -    | -    | -    | 2    | 1    | 1    |

| b) CO and3 Key Performance Indicators mapping |                                                                                                                                                                     |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|-----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| CO1                                           | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1,2.1.2,2.1.3,2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 5.1.1, 6.1.1, 7.1.1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO2                                           | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1,2.1.2,2.1.3,2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 5.1.1, 6.1.1, 7.1.1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO3                                           | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1,2.1.2,2.1.3,2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 5.1.1, 6.1.1, 7.1.1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO4                                           | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 3.1.1,                                                            |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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|     |                                                                                                                                                                                             |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|     | 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 5.1.1, 6.1.1, 7.1.1                                                                                                          |
| CO5 | 1.1.1, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.1, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 4.1.1, 4.1.2, 4.2.1, 5.1.1, 6.1.1, 7.1.1 |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         |                   | 60                   | 40             |                |                   |                 | 100     |
| CAT2                                                         |                   | 40                   | 40             | 20             |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 40                   | 40             | 20             |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 40                   | 40             | 20             |                   |                 | 100     |
| ESE                                                          |                   | 60                   | 40             |                |                   |                 | 100     |



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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                               |                                |   |   |           |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|--------------------------------|---|---|-----------|---|
| 22NPE\$43                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                               | PRINCIPLES OF CMOS VLSI DESIGN |   |   |           |   |
| PREREQUISITES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                               | CATEGORY                       | L | T | P         | C |
| 1. 22NPC302 ANALOG ELECTRONICS<br>2. 22NPC408 DIGITAL ELECTRONICS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                               | PE                             | 3 | 0 | 0         | 3 |
| COURSE OBJECTIVE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | To impart knowledge on CMOS VLSI design for digital circuits. |                                |   |   |           |   |
| UNIT - I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | MOS TRANSISTOR BASICS                                         |                                |   |   | 9 Periods |   |
| MOSFET as a Switch - MOSFET: Structure, Types, Threshold Voltage, Current Voltage Characteristics, Transfer Characteristics - Short Channel Effect - Body Effect - Second Order Effect: Body Effect, Channel Length Modulation - Types of Device Scaling: Velocity Saturation, Drain Induced Barrier Lowering, Punchthrough - Model for Manual Analysis - MOS Structure Capacitance: MOS Overlap Capacitance, Channel Capacitance, Junction Capacitance - Source to Drain Resistance                                                                                                                                                                                                                                                                      |                                                               |                                |   |   |           |   |
| UNIT - II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | CMOS INVERTER BASICS                                          |                                |   |   | 9 Periods |   |
| Basic Idea of CMOS Inverter - Switch Model of Inverter - Static Behavior - Voltage Transfer Characteristics - Switching Threshold - Noise Margin - Gain Calculation - Propagation Delay - Inverter Capacitance - Optimum NMOS - PMOS Ratio - Sizing of Inverter Chain - Dynamic Power Dissipation - Source of Leakage Current - Static Power Dissipation - Power-delay Product - Energy-delay Product - Power Analysis                                                                                                                                                                                                                                                                                                                                    |                                                               |                                |   |   |           |   |
| UNIT - III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | COMBINATIONAL LOGIC DESIGN                                    |                                |   |   | 9 Periods |   |
| Introduction - Static Logic Design - Choice of Push-up and Pull-down Network - Two Input NAND gate- CMOS Gates: Static Properties, Propagation Delay, Problems - Design techniques of Large Fan-in - Power Consumption - Dynamic Transition - Design Technique to Reduce Switching Activity - Ratioed Logic - Pseudo NMOS Inverter - Design Considerations - Pass Transistor: Logic - Voltage Swing - VTC - Differential Pass Transistor: Logic, Properties - Robust and Efficient Pass Transistor Design: Level Restoration, Multiple Threshold Transistor- Transmission Gate Logic - Performance of Pass Transistor and Transmission Gate                                                                                                               |                                                               |                                |   |   |           |   |
| UNIT - IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | DYNAMIC LOGIC DESIGN                                          |                                |   |   | 9 Periods |   |
| Dynamic CMOS Design: Basic Principle, Properties, Speed, Power Dissipation - Signal Integrity Issues: Charge Leakage, Charge Sharing, Capacitive Coupling, Feed-through - Cascading Dynamic Gates - Domino Logic and its Properties - Non-inverting Problem of Domino Logic - Basics of Logic Efforts - Calculation of Logic Efforts for Logic Gates - Multistage Logic Network: Design, Choosing the Length of the Path - FORK Design - Logic Efforts of Asymmetric Gates                                                                                                                                                                                                                                                                                |                                                               |                                |   |   |           |   |
| UNIT - V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | SEQUENTIAL LOGIC, MEMORY AND ITS DESIGN                       |                                |   |   | 9 Periods |   |
| Introduction - Timing Metrics for Sequential Circuits - Classification of Memory Elements - Static Latches and Registers: Bi-stability Principle, Multiplexer based Latches, Low Voltage Static Latches, Master-slave Edge Triggered Register - Dynamic Latches and Registers: Dynamic Transmission Gate Edge Triggered Registers, C <sup>2</sup> MOS Register, Pulse Registers, Sense Amplifiers based Registers - Pipelining: Latch versus Register based Pipelines - Clocking Strategies: Introduction, Clock Skew, Clock Jitter -Sources and Impact of Skew and Jitter - Design Techniques to Reduce Skew and Jitter - Clock Distribution - Introduction - Classification - Architecture - Memory Core - ROM - Non Volatile Read-Write memories - RAM |                                                               |                                |   |   |           |   |
| Contact Periods: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                               |                                |   |   |           |   |
| Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                               |                                |   |   |           |   |

**TEXT BOOKS:**

|   |                                                                                                                                             |
|---|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Weste and Eshraghian, " <i>Principles of CMOS VLSI Design</i> " Addison Wesley, Latest Edition                                              |
| 2 | Bushnell and Agrawal, " <i>Essentials of VLSI Testing for digital, memory and mixed-signal VLSI Circuits</i> ", Kluwer Academic Publishers. |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

## REFERENCES:

|   |                                                                                                                                              |
|---|----------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Rabaey, Chandrakasan and Nikolic, " <i>Digital Integrated Circuit: A Design Perspective</i> ", Prentice Hall, 2 <sup>nd</sup> Edition, 2003. |
| 2 | Neil H.E. Weste and David Money Harris, " <i>CMOS VLSI DESIGN</i> ", Pearson Education, 4 <sup>th</sup> Edition, 2015.                       |
| 3 | R. Jacob Baker, " <i>CMOS: Circuit Design, Layout, and Simulation</i> ", Wiley-IEEE, 4 <sup>th</sup> Edition, 2019.                          |
| 4 | Wayne Wolf, Marilyn Wolf, " <i>Modern VLSI Design: System on Chip Design</i> ", Pearson Education, New Delhi, 2008.                          |

| COURSE OUTCOMES                                             |                                                            | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                            |                         |
| CO1                                                         | Explain the working and characteristics of CMOS transistor | K2                      |
| CO2                                                         | Describe the operation of CMOS inverter                    | K2                      |
| CO3                                                         | Design CMOS circuits for boolean expressions               | K3                      |
| CO4                                                         | Design CMOS circuits for sequential circuits               | K3                      |
| CO5                                                         | Elaborate on the different types of memory elements        | K2                      |

## COURSE ARTICULATION MATRIX

| a) CO/PO Mapping                             |                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|----------------------------------------------|-------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                      | PO1                                             | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                          | 2                                               | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO2                                          | 2                                               | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO3                                          | 2                                               | 1   | 1   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO4                                          | 2                                               | 1   | 1   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| CO5                                          | 2                                               | 1   | 1   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| 22NPES43                                     | 2                                               | 1   | 1   | -   | 1   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | -    |
| b) CO and Key Performance Indicators mapping |                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                          | 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.3.1, 3.2.3        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                          | 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.3.1, 3.2.3        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                          | 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.3.1, 3.2.3, 5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                          | 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.3.1, 3.2.3, 5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                          | 1.2.1, 1.3.1, 2.1.2, 2.1.3, 2.3.1, 3.2.3, 5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

## ASSESSMENT PATTERN - THEORY

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 50                   | 30             |                 |                   |                 | 100     |
| CAT2                                                         |                   | 60                   | 40             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 40                   | 60             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 40                   | 60             |                 |                   |                 | 100     |
| ESE                                                          | 30                | 40                   | 30             |                 |                   |                 | 100     |

|                 |                                 |
|-----------------|---------------------------------|
| <b>22NPES44</b> | <b>INDUSTRIAL DATA NETWORKS</b> |
|-----------------|---------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                   |                                                                                                                       |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                           | To impart students the underpinning knowledge on the data communication and widely used industrial network protocols. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                   | <b>DATA COMMUNICATION FUNDAMENTALS</b>                                                                                | <b>9 Periods</b> |  |
| Communication goals- Categories of Communication: Simplex, Half-duplex and Duplex - Serial and parallel transmission - Network protocol -Communication model: ISO/OSI, TCP/IP- Performance parameters of packet network- Messaging Patterns in Industrial Communication Protocols: request-response and publish-subscribe models. |                                                                                                                       |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                  | <b>SERIAL DATA COMMUNICATION PROTOCOLS</b>                                                                            | <b>9 Periods</b> |  |
| Serial asynchronous communication protocol: RS 232 C- RS 485 - GPIB – USB - I2C                                                                                                                                                                                                                                                   |                                                                                                                       |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                 | <b>PROTOCOLS FOR FIELD INSTRUMENTS AND CONTROLLERS</b>                                                                | <b>9 Periods</b> |  |
| HART (Highway Addressable Remote Transducer) - IO-Link - AS-Interface (Actuator Sensor Interface) - DeviceNet -Modbus - PROFIBUS (Process Field Bus) - PROFINET (Process Field Net) - EtherNet/IP (Ethernet Industrial Protocol) - EtherCAT (Ethernet for Control Automation Technology) - Foundation Fieldbus                    |                                                                                                                       |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                  | <b>PROTOCOLS FOR ENERGY, AUTOMOTIVE AND BUILDING AUTOMATION SYSTEMS</b>                                               | <b>9 Periods</b> |  |
| IEC 60870-5-104 - DNP3 - IEC 61850 - M-Bus - SERCOS (Serial Real-time Communication System) - BACnet (Building Automation and Control Networks) - KNX - CANopen                                                                                                                                                                   |                                                                                                                       |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                   | <b>WIRELESS AND MISCELLANEOUS PROTOCOLS</b>                                                                           | <b>9 Periods</b> |  |
| Bluetooth - Wi-Fi - WirelessHART - Zigbee - OPC (OLE for Process Control) - MQTT                                                                                                                                                                                                                                                  |                                                                                                                       |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                |                                                                                                                       |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                              |                                                                                                                       |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                      |
|---|----------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Data Communications and Networking, Behrouz A. Forouzan, 5<sup>th</sup> Edition, Mc Graw Hill, 2017</i>           |
| 2 | <i>Industrial Data Communications, Lawrence (Larry) M. Thompson and Tim Shaw , 5<sup>th</sup> Edition, ISA, 2015</i> |

**REFERENCES:**

|   |                                                                                                                                                                                                                      |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>"Practical Industrial Data Networks: Design, Installation and Troubleshooting", Steve Mackay , Edwin Wright, Deon Reyn'ders , John Parker, Newnes, 2004</i>                                                       |
| 2 | <i>"Industrial Network Basics", Gary D Anderson , 1<sup>st</sup> Edition, 2021</i>                                                                                                                                   |
| 3 | <i>"Industrial Automation from Scratch: A hands-on guide to using sensors, actuators, PLCs, HMIs, and SCADA to automate industrial processes", Olushola Akande, 1<sup>st</sup> Edition, ISBN 9781800569386, 2023</i> |
| 4 | <i>"Computer Networks ", Andrew Tanenbaum , David Wetherall, 5<sup>th</sup> Edition, Pearson, 2010</i>                                                                                                               |

| <b>COURSE OUTCOMES</b>                                      |                                                             | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                             |                                |
| CO1                                                         | Discuss the fundamental concepts of Data Communication      | K2                             |
| CO2                                                         | Exhibit the understanding of serial communication protocols | K2                             |

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|     |                                                                                                      |    |
|-----|------------------------------------------------------------------------------------------------------|----|
| CO3 | Assimilate various protocols available for data communications between sensors and controllers       | K2 |
| CO4 | Comprehend protocols used for Energy, Automotive and Building Automation Systems                     | K2 |
| CO5 | Demonstrate the understanding of wireless and other vital protocols used in industrial data networks | K2 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                      | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 1    | 2    | 3    |
| CO2                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 1    | 2    | 3    |
| CO3                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 1    | 2    | 3    |
| CO4                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 1    | 2    | 3    |
| CO5                                                 | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 1    | 2    | 3    |
| <b>22NPE\$44</b>                                    | 2                                                                                                                        | -   | 3   | 2   | -   | -   | -   | -   | 3   | 2    | -    | -    | 1    | 2    | 3    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                          |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1 1.4.1, 2.2.2, 2.2.4, 2.3.2, 3.1.1, 4.1.1, 4.1.3, 4.1.4, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.3.1, 9.3.2, 10.1.1.1, 10.1.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing( K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| CAT1                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 10                | 90                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 10                | 90                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 10                | 90                   |                |                 |                   |                 | 100     |
| ESE                                                          | 10                | 90                   |                |                 |                   |                 | 100     |

|                 |                                 |
|-----------------|---------------------------------|
| <b>22NPES45</b> | <b>MEMS AND NANO TECHNOLOGY</b> |
|-----------------|---------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>PE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                          |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To illustrate the fundamentals of MEMS, nanotechnology and their importance in multidisciplinary fields. |                  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>OVERVIEW OF MEMS</b>                                                                                  | <b>9 Periods</b> |
| Introduction: emergence, devices and application, scaling issues, materials for MEMS, Thin film deposition, lithography and etching.                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                          |                  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>MICROSYSTEM FABRICATION PROCESSES</b>                                                                 | <b>9 Periods</b> |
| Introduction to Microsystems Fabrication Process: Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition, Physical Vapour Deposition-Sputtering, Deposition by Epitaxial, Etching. LIGA Process: General Description of LIGA Process, Materials for Substrates and Photo resists, Electroplating and SLIGA Process.                                                                                                                                                                 |                                                                                                          |                  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>NANOTECHNOLOGY</b>                                                                                    | <b>9 Periods</b> |
| Introduction and overview of Quantum concepts - Overview of 1st, 2nd and 3rd generation biomaterials - structures and properties: Carbon based, Metal based, bio-nano materials and hybrids, Bucky Ball, Nano-tubes, Diamond like carbon (DLC), Quantum Dots, Magnetic, Nano Shells, Dendrimers, Nano-carriers, Nano-crystals, Nano-wires, Nano-membranes, Thin films, hybrid biological/inorganic, protein and DNA based nanostructures. Nano-safety Issues: Toxicology health effects caused by nano-particles. |                                                                                                          |                  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>MICRO AND NANO-ELECTROMECHANICAL SYSTEMS AND MICROFLUIDICS</b>                                        | <b>9 Periods</b> |
| MEMS/NEMS: Magnetic, Chemical and Mechanical Transducers –Sensing and Actuators. Microfluidics: Laminar flow - Hagen-Peouisselle equation - basic fluid ideas, Special considerations of flow in small channels - mixing - Micro valves and micro pumps.                                                                                                                                                                                                                                                          |                                                                                                          |                  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>INDUSTRIAL APPLICATIONS</b>                                                                           | <b>9 Periods</b> |
| Molecular electronics, molecular switches, mechanical cutting tools, machine components, magnets, DLC coated grinding wheels. Electrical, electronic, solar cells, Batteries, fuel cells, and Nanofilters. Medical nanotechnology: Diagnostics, Therapeutics, Drug delivery and Nanosurgery.                                                                                                                                                                                                                      |                                                                                                          |                  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                          |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                          |                  |

**TEXT BOOKS:**

|   |                                                                                                                                                    |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Tai Ran Hsu, “ <i>Mems &amp; Microsystem Design and Manufacture</i> ”, 3 <sup>rd</sup> Edition, Tata McGraw Hill, 2017.                            |
| 2 | B.S. Murty., P. Shankar., B.Raj, et.al, “ <i>Textbook of Nanosciences and Nanotechnology</i> ”, University Press (India) Pvt. Ltd. VCH, XII. 2013. |
| 3 | Bharat Bhushan, “ <i>Handbook of Nanotechnology</i> ”, 3 <sup>rd</sup> Edition, Springer, 2010.                                                    |

**REFERENCES:**

|   |                                                                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Krzysztof Iniewski., Vikas Choudhary, “ <i>MEMS: Fundamental Technology and Applications (Devices, Circuits, and Systems)</i> ”, CRC press, 2013.         |
| 2 | Marc Madou, “ <i>Fundamentals of Micro fabrication</i> ”, The science of Miniaturization, 2 <sup>nd</sup> , CRC Press, 2017.                              |
| 3 | Julian W. Gardner and Vijay K. Varadan, “ <i>Micro sensors, MEMS, and Smart devices</i> ”, John Wiley & Sons Ltd, 2002.                                   |
| 4 | Michael Wilson, Kamali Kannangara, Geoff Smith, “ <i>Nanotechnology, Basic Science and Emerging technologies</i> ”, Taylor & Francis Group, 2002.         |
| 5 | Akhlesh Lakhtakia “ <i>Hand Book of Nano Technology, Nano-meter Structure, Theory, Modelling and Simulations</i> ”, Prentice-Hall of India (P) Ltd, 2007. |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Analyze Mems fundamentals.                                                     | K2                                     |
| CO2                                                                                   | Describe the methods involving preparation of micro system fabrication process | K2                                     |
| CO3                                                                                   | Explore the information on Nanotechnology                                      | K2                                     |
| CO4                                                                                   | Explain the Micro & Nano-Electromechanical Systems and Microfluidics           | K2                                     |
| CO5                                                                                   | Illustrate the industrial applications of nanotechnology.                      | K2                                     |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                       |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-----------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                   | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                     | 1   | -   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | 2    |
| CO2                                                 | 3                                                                     | 1   | -   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | 2    |
| CO3                                                 | 3                                                                     | 1   | -   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | 2    |
| CO4                                                 | 3                                                                     | 1   | -   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | 2    |
| CO5                                                 | 3                                                                     | 1   | -   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | 2    |
| <b>22NPES45</b>                                     | 3                                                                     | 1   | -   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 3    | -    | 2    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                       |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.2.,2, 2.1.1,2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.2.,2, 2.1.1,2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.2.,2, 2.1.1,2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.1.1, 1.1.2, 1.2.1, 1.2.,2, 2.1.1,2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4, |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.1.1, 1.1.2, 1.2.1, 1.2.,2, 2.1.1,2.1.2, 4.1.1, 4.1.2, 4.1.3, 4.1.4. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                                    |                      |                         |                   |                    |                      |                    |         |
|-----------------------------------------------------------------------|----------------------|-------------------------|-------------------|--------------------|----------------------|--------------------|---------|
| Test/Bloom's<br>Category                                              | Remembering<br>(K1)% | Understanding<br>(K2) % | Applying<br>(K3)% | Analyzing(<br>K4)% | Evaluating<br>(K5) % | Creating<br>(K6) % | Total % |
| CAT1                                                                  | 20                   | 80                      |                   |                    |                      |                    | 100     |
| CAT2                                                                  | 20                   | 80                      |                   |                    |                      |                    | 100     |
| Individual<br>Assessment 1 /Case<br>Study 1/ Seminar 1 /<br>Project1  | 20                   | 80                      |                   |                    |                      |                    | 100     |
| Individual<br>Assessment 2 /Case<br>Study 2/ Seminar 2 /<br>Project 2 | 20                   | 80                      |                   |                    |                      |                    | 100     |
| ESE                                                                   | 20                   | 80                      |                   |                    |                      |                    | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|           |                              |
|-----------|------------------------------|
| 22NPE\$46 | CONCEPTS OF MACHINE LEARNING |
|-----------|------------------------------|

| PREREQUISITES                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                             | CATEGORY | L | T | P         | C |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------|---|---|-----------|---|
| NIL                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                             | PE       | 3 | 0 | 0         | 3 |
| COURSE OBJECTIVE                                                                                                                                                                                                                                                                                                                                                                               | To introduce the need for machine learning and understand its trends and design appropriate algorithms for posted problems. |          |   |   |           |   |
| UNIT - I                                                                                                                                                                                                                                                                                                                                                                                       | NEURAL NETWORK AND GENETIC ALGORITHM                                                                                        |          |   |   | 9 Periods |   |
| Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.                                                                                                                                                       |                                                                                                                             |          |   |   |           |   |
| UNIT - II                                                                                                                                                                                                                                                                                                                                                                                      | MACHINE LEARNING – INTRODUCTION                                                                                             |          |   |   | 9 Periods |   |
| Machine Learning- Types- Curse of dimensionality – Overfitting and Linear regression – Bias and variance- Learning curve – Classification – Error and noise – Parametric and non-parametric models.                                                                                                                                                                                            |                                                                                                                             |          |   |   |           |   |
| UNIT - III                                                                                                                                                                                                                                                                                                                                                                                     | BAYESIAN AND COMPUTATIONAL LEARNING                                                                                         |          |   |   | 9 Periods |   |
| Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.                                                                          |                                                                                                                             |          |   |   |           |   |
| UNIT - IV                                                                                                                                                                                                                                                                                                                                                                                      | INSTANT BASED LEARNING                                                                                                      |          |   |   | 9 Periods |   |
| Nearest Neighbour Algorithm- Distance Functions - K- Nearest Neighbour Learning - Decision Boundaries - Locally weighted Regression – Radial Basis Functions – Case Based Learning- Generic Properties of case based learning.                                                                                                                                                                 |                                                                                                                             |          |   |   |           |   |
| UNIT - V                                                                                                                                                                                                                                                                                                                                                                                       | ADVANCED LEARNING                                                                                                           |          |   |   | 9 Periods |   |
| Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation based Learning – First Order Combined Learning (FOCL) Algorithm – Reinforcement Learning – Task – Q-Learning – Temporal Difference Learning. |                                                                                                                             |          |   |   |           |   |
| Contact Periods: 45 Periods                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                             |          |   |   |           |   |
| Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods                                                                                                                                                                                                                                                                                                  |                                                                                                                             |          |   |   |           |   |

**TEXT BOOKS:**

|   |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------|
| 1 | Tom M. Mitchell, “ <b>Machine Learning</b> ”, McGraw-Hill Education (India) Private Limited, 1 <sup>st</sup> edition, 2017. |
| 2 | Stephen Marsland, “ <b>Machine Learning: An Algorithmic Perspective</b> ”, CRC Press, 2 <sup>nd</sup> edition, 2014.        |

**REFERENCES:**

|   |                                                                                                                                                            |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Kevin P. Murphy, “ <b>Machine Learning: A Probabilistic Perspective</b> ”, MIT Press, Illustrated edition, 2012.                                           |
| 2 | Ethem Alpaydin “ <b>Introduction to Machine Learning (Adaptive Computation and Machine Learning)</b> ”, The MIT Press, 4 <sup>th</sup> edition, 2020.      |
| 3 | Laurene Fausett, “ <b>Fundamentals of Neural Networks, Architectures, Algorithms and Applications</b> ”, Pearson Education, 2 <sup>nd</sup> edition, 2008. |
| 4 | Christopher Bishop, “ <b>Pattern Recognition and Machine Learning</b> ”, Springer, 1 <sup>st</sup> edition, 2006                                           |

| COURSE OUTCOMES                                             |                                                                 | Bloom's Taxonomy Mapped |
|-------------------------------------------------------------|-----------------------------------------------------------------|-------------------------|
| Upon Completion of the course, the students will be able to |                                                                 |                         |
| CO1                                                         | Familiarize the neural and genetic architectures.               | K2                      |
| CO2                                                         | Elaborate the terminologies and techniques of machine learning. | K2                      |
| CO3                                                         | Outline the concepts of Bayesian learning.                      | K2                      |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|     |                                                                            |    |
|-----|----------------------------------------------------------------------------|----|
| CO4 | Describe K-nearest Neighbor and advanced Learning                          | K2 |
| CO5 | Apply machine learning algorithms to solve problems of moderate complexity | K3 |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|-----------------------------------------------------|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                             | PO1                                  | PO2      | PO3      | PO4      | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PO12     | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 3                                    | 3        | 3        | 3        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO2                                                 | 3                                    | 3        | 3        | 3        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO3                                                 | 3                                    | 3        | 2        | 3        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO4                                                 | 3                                    | 3        | 3        | 3        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| CO5                                                 | 3                                    | 3        | 3        | 3        | 1        | -        | -        | -        | -        | -        | -        | 1        | -        | 2        | 1        |
| <b>22NPE\$46</b>                                    | <b>3</b>                             | <b>3</b> | <b>3</b> | <b>3</b> | <b>1</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>-</b> | <b>1</b> | <b>-</b> | <b>2</b> | <b>1</b> |
| <b>b) CO and Key Performance Indicators mapping</b> |                                      |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                                 | 1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

**ASSESSMENT PATTERN - THEORY**

| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing(K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|-------------------|----------------------|----------------|----------------|-------------------|-----------------|---------|
| CAT1                                                         | 20                | 50                   | 30             |                |                   |                 | 100     |
| CAT2                                                         | 20                | 50                   | 30             |                |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                   | 50                   | 50             |                |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                   | 50                   | 50             |                |                   |                 | 100     |
| ESE                                                          | 40                | 40                   | 20             |                |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                            |                      |   |                       |           |                   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|----------------------|---|-----------------------|-----------|-------------------|
| 22COES01                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | DISASTER MANAGEMENT AND MITIGATION<br>(Common to All Branches)                                                             |                      |   |                       |           |                   |
| PREREQUISITES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                            | CATEGORY             | L | T                     | P         | C                 |
| NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            | OE                   | 3 | 0                     | 0         | 3                 |
| Course Objective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | To impart knowledge to create appropriate planning, preparation and response for emergency treatment in disaster situation |                      |   |                       |           |                   |
| UNIT – I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | INTRODUCTION TO DISASTERS                                                                                                  |                      |   |                       | 9 Periods |                   |
| Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Classification, Causes, Impacts - Global Trends in Disasters: Urban Disasters, Pandemics, Complex Emergencies, Climate Change- Dos and Don'ts during various types of Disasters.                                                                                                                                                                                                                                                                               |                                                                                                                            |                      |   |                       |           |                   |
| UNIT – II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | HAZARDS AND RISK VULNERABILITY                                                                                             |                      |   |                       | 9 Periods |                   |
| Hazard Identification and Hazard Profiling - Hazard Analysis - Types of hazards - Natural and technological Components of Risk- likelihood and Consequence, Trends and Computation of likelihood and Consequence. Risk Evaluation – Purpose, Risk Acceptability, Alternatives, Personnel. Political/ Social, Economic. Vulnerability-Physical Profile, Social Profile, Environmental Profile, Economic Profile - Factors Influencing Vulnerability, Risk Perception.                                                                       |                                                                                                                            |                      |   |                       |           |                   |
| UNIT – III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | MITIGATION AND PREPAREDNESS                                                                                                |                      |   |                       | 9 Periods |                   |
| Mitigation - Types, Obstacles, Assessment and Selection of Mitigation options, Emergency Response capacity, Incorporating Mitigation into Development and Relief Projects. Preparedness- Government Preparedness, Public Preparedness, Media as a Public educator. Obstacles to public education and preparedness.                                                                                                                                                                                                                         |                                                                                                                            |                      |   |                       |           |                   |
| UNIT – IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | RESPONSE AND RECOVERY                                                                                                      |                      |   |                       | 9 Periods |                   |
| Response the Emergency- Pre disaster, post disaster, Provision of Water, Food and Shelter, Volunteer Management, Command, Control and Coordination. Recovery- Short Term and Long-term Recovery- Components of Recovery- Planning, Coordination, Information, Money and Supplies, Allocation of Relief Funds, Personnel. Types of Recovery- Government, Infrastructure, Debris Removal Disposal and Processing, Environment, Housing, Economic and Livelihood, Individual, Family and Social Recovery- Special Considerations in Recovery. |                                                                                                                            |                      |   |                       |           |                   |
| UNIT – V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES                                                                         |                      |   |                       | 9 Periods |                   |
| Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies.                                                                                                                                                                                                                                                                                                                                         |                                                                                                                            |                      |   |                       |           |                   |
| Contact Periods:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                            |                      |   |                       |           |                   |
| Lecture: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                            | Tutorial: 00 Periods |   | Practical: 00 Periods |           | Total: 45 Periods |

**TEXT BOOKS :**

|   |                                                                                                             |
|---|-------------------------------------------------------------------------------------------------------------|
| 1 | <i>Singhal J.P. “Disaster Management”, Laxmi Publications, 2010.</i>                                        |
| 2 | <i>Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012.</i> |

**REFERENCES:**

|   |                                                                                                                    |
|---|--------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005.</i>                             |
| 2 | <i>Government of India, National Disaster Management Policy, 2009.</i>                                             |
| 3 | <i>Gupta Anil K, Sreeja S. Nair. “Environmental Knowledge for Disaster Risk Management”, NIDM, New Delhi, 2011</i> |
| 4 | <i>Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010</i>    |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

## COURSE OUTCOMES:

Upon completion of the course, the students will be able to:

## Bloom's Taxonomy Mapped

|     |                                                                                            |    |
|-----|--------------------------------------------------------------------------------------------|----|
| CO1 | Identify the types of disasters, causes and their impact on environment and society        | K2 |
| CO2 | Assess vulnerability and various methods of risk reduction measures as well as mitigation. | K2 |
| CO3 | Comprehend the mitigation and preparedness process.                                        | K2 |
| CO4 | Describe about response and recovery process during disaster.                              | K2 |
| CO5 | Perform disaster damage assessment and management.                                         | K2 |

## COURSE ARTICULATION MATRIX:

### a) CO and PO Mapping

| COs/POs  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
|----------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|-------|------|------|------|
| CO1      | 1   | -   | 1   | -   | 2   | 3   | 3   | 2   | 2   | 2     | -     | 3     | 2    | -    | 2    |
| CO2      | 1   | -   | 1   | -   | 2   | 3   | 3   | 2   | 2   | 2     | -     | 3     | 2    | -    | 2    |
| CO3      | 1   | -   | 1   | -   | 2   | 3   | 3   | 2   | 2   | 2     | -     | 3     | 2    | -    | 2    |
| CO4      | 1   | -   | 1   | -   | 2   | 3   | 3   | 2   | 2   | 2     | -     | 3     | 2    | -    | 2    |
| CO5      | 1   | -   | 1   | -   | 2   | 3   | 3   | 2   | 2   | 2     | -     | 3     | 2    | -    | 2    |
| 22COES01 | 1   | -   | 1   | -   | 2   | 3   | 3   | 2   | 2   | 2     | -     | 3     | 2    | -    | 2    |

1 – Slight, 2 – Moderate, 3 – Substantial

### b) CO and Key Performance Indicators Mapping

|     |                                                                                                                                 |
|-----|---------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3        |
| CO2 | 1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3 |
| CO3 | 1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3 |
| CO4 | 1.2.1, 3.1.5, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3 |
| CO5 | 1.2.1, 3.3.6, 5.1.1, 5.2.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.1, 9.1.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3 |

## ASSESSMENT PATTERN – THEORY

| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| CAT1                                                         | 40                 | 40                   | 20              | -                | -                 | -               | 100     |
| CAT2                                                         | 40                 | 40                   | 20              | -                | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                  | 25                   | 50              | 25               | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                  | 25                   | 50              | 25               | -                 | -               | 100     |
| ESE                                                          | 30                 | 30                   | 40              | -                | -                 | -               | 100     |

|                 |                                                                |
|-----------------|----------------------------------------------------------------|
| <b>22COES02</b> | <b>WATER SANITATION AND HEALTH</b><br>(Common to All Branches) |
|-----------------|----------------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                            |               |            |                  |                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------|------------------|------------------|
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                        | To understand the overview of Environment, Health and Safety (EHS) in industries and related Indian regulations, types of Health hazards, effect, assessment and control methods and EHS Management System |               |            |                  |                  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                | <b>INTRODUCTION</b>                                                                                                                                                                                        |               |            | <b>9 Periods</b> |                  |
| Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice - Role of Trade Union Safety Representatives – Ergonomics.                                                          |                                                                                                                                                                                                            |               |            |                  |                  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                               | <b>OCCUPATIONAL HEALTH AND HYGIENE</b>                                                                                                                                                                     |               |            | <b>9 Periods</b> |                  |
| Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits - Hierarchy of control measures - Role of personal protective equipment and the selection criteria.                                      |                                                                                                                                                                                                            |               |            |                  |                  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                              | <b>WORKPLACE SAFETY AND SAFETY SYSTEMS</b>                                                                                                                                                                 |               |            | <b>9 Periods</b> |                  |
| Features of Satisfactory and Safe design of work premises – good housekeeping - lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels. |                                                                                                                                                                                                            |               |            |                  |                  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                               | <b>HAZARDS AND RISK MANAGEMENT</b>                                                                                                                                                                         |               |            | <b>9 Periods</b> |                  |
| Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation - Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies.                               |                                                                                                                                                                                                            |               |            |                  |                  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                | <b>ENVIRONMENTAL</b>                                                                                                                                                                                       | <b>HEALTH</b> | <b>AND</b> | <b>SAFETY</b>    | <b>9 Periods</b> |
|                                                                                                                                                                                                                                                                                                                | <b>MANAGEMENT</b>                                                                                                                                                                                          |               |            |                  |                  |
| Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Strucure and Clauses-Case Studies.                                                                                                             |                                                                                                                                                                                                            |               |            |                  |                  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                            |               |            |                  |                  |
| <b>Lecture: 45 Periods      Tutorial: 00 Periods      Practical: 00 Periods      Total: 45 Periods</b>                                                                                                                                                                                                         |                                                                                                                                                                                                            |               |            |                  |                  |

**TEXT BOOKS:**

|   |                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India.</i> |
| 2 | <i>Dr.K.U.Mistry, Siddharth Prakashan, “Fundamentals of Industrial Safety and Health”, 2012</i>                     |

**REFERENCES:**

|   |                                                                                                                                                                      |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Bill Taylor, “Effective Environmental, Health, and Safety Management Using the Team Approach”, Culinary and Hospitality Industry Publications Services, 2005.</i> |
| 2 | <i>Nicholas P.Cheremisinoff and Madelyn L. Graffia, “Environmental and Health and Safety Management”, William Andrew Inc. NY, 1995.</i>                              |
| 3 | <i>Brian Gallant, “The Facility Manager's Guide to Environmental Health and Safety”, Government Inst Publ., 2007.</i>                                                |
| 4 | <i><a href="https://archive.nptel.ac.in/courses/114/106/114106017/">https://archive.nptel.ac.in/courses/114/106/114106017/</a></i>                                   |

| <b>COURSE OUTCOMES:</b><br>Upon completion of the course, the students will be able to: |                                                                                      | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                     | Outline the needs for EHS in industries and related Indian regulations               | K2                                     |
| CO2                                                                                     | Assess the various types of Health hazards, effect, assessment and control methods   | K2                                     |
| CO3                                                                                     | Identify the various safety systems in working environments                          | K2                                     |
| CO4                                                                                     | Select the methodology for preparation of Emergency Plans and Accident investigation | K3                                     |
| CO5                                                                                     | Describe the EHS Management System and its elements                                  | K2                                     |

**COURSE ARTICULATION MATRIX:**

| <b>a) CO and PO Mapping</b>                         |                                                                                                                                 |     |     |     |     |     |     |     |     |       |       |       |      |      |      |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|-------|------|------|------|
| COs/POs                                             | PO1                                                                                                                             | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                                                                                               | -   | 1   | -   | 3   | 3   | 3   | 2   | 1   | -     | 2     | -     | 1    | 1    | -    |
| CO2                                                 | 2                                                                                                                               | -   | 1   | -   | 3   | 3   | 3   | 2   | 1   | -     | 2     | -     | 1    | 1    | -    |
| CO3                                                 | 2                                                                                                                               | -   | 1   | -   | 3   | 3   | 3   | 2   | 1   | -     | 2     | -     | 1    | 1    | -    |
| CO4                                                 | 2                                                                                                                               | -   | 1   | -   | 3   | 3   | 3   | 2   | 1   | -     | 2     | -     | 1    | 1    | -    |
| CO5                                                 | 2                                                                                                                               | -   | 1   | -   | 2   | 3   | 3   | 2   | 1   | -     | 2     | -     | 1    | 1    | -    |
| <b>22COES02</b>                                     | 2                                                                                                                               | -   | 1   | -   | 3   | 3   | 3   | 2   | 1   | -     | 2     | -     | 1    | 1    | -    |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                                                 |     |     |     |     |     |     |     |     |       |       |       |      |      |      |
| <b>b) CO and Key Performance Indicators Mapping</b> |                                                                                                                                 |     |     |     |     |     |     |     |     |       |       |       |      |      |      |
| CO1                                                 | 1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1. |     |     |     |     |     |     |     |     |       |       |       |      |      |      |
| CO2                                                 | 1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1. |     |     |     |     |     |     |     |     |       |       |       |      |      |      |
| CO3                                                 | 1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1. |     |     |     |     |     |     |     |     |       |       |       |      |      |      |
| CO4                                                 | 1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1. |     |     |     |     |     |     |     |     |       |       |       |      |      |      |
| CO5                                                 | 1.2.1, 1.3.1, 3.1.4, 3.1.5, 5.1.1, 5.2.1, 5.2.2, 5.3.1, 6.1.1, 6.2.1, 7.1.2, 7.2.1, 7.2.2, 8.1.1, 8.2.2, 9.1.2, 11.1.1, 11.2.1. |     |     |     |     |     |     |     |     |       |       |       |      |      |      |

| <b>ASSESSMENT PATTERN – THEORY</b>                           |                    |                      |                 |                  |                   |                 |         |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 40                 | 40                   | 20              | -                | -                 | -               | 100     |
| CAT2                                                         | 40                 | 40                   | 20              | -                | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                  | 25                   | 50              | 25               | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                  | 25                   | 50              | 25               | -                 | -               | 100     |
| ESE                                                          | 30                 | 30                   | 40              | -                | -                 | -               | 100     |

|                 |                                                                           |
|-----------------|---------------------------------------------------------------------------|
| <b>22MOES03</b> | <b>NANOTECHNOLOGY AND SURFACE ENGINEERING</b><br>(Common to All Branches) |
|-----------------|---------------------------------------------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>OE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                           |                    |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|--|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                              | To educate the production techniques and characterization techniques of nano materials and to familiarize about the surface modification techniques using nano materials. |                    |  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                                                       | <b>ELEMENTS OF NANO-SCIENCE AND NANOTECHNOLOGY</b>                                                                                                                        | <b>(9 Periods)</b> |  |
| Engineering scale of nanotechnology, different classes of nano-materials, synthesis of nano-materials, fabrication and characterization of nanostructures, Engineering applications- Cosmetics and Consumer Goods, Nano Sensor, Nano catalysts, Water Treatment and the Environment, Paints, Food and Agriculture Industry.                           |                                                                                                                                                                           |                    |  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                                                      | <b>NANOTECHNOLOGY AND CERAMICS</b>                                                                                                                                        | <b>(9 Periods)</b> |  |
| Introduction, Vapor Condensation Methods, Sputtering, Laser Method, Spray Pyrolysis, Thermo Chemical /Flame Decomposition of metal organic Precursors methods                                                                                                                                                                                         |                                                                                                                                                                           |                    |  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                                                                     | <b>CHARACTERIZATION OF NANOMATERIALS</b>                                                                                                                                  | <b>(9 Periods)</b> |  |
| X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy, UV / Visible Spectroscopy.                                                                                                                                                                                              |                                                                                                                                                                           |                    |  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                                                                      | <b>SURFACE ENGINEERING</b>                                                                                                                                                | <b>(9 Periods)</b> |  |
| Introduction to surface engineering, Scope of surface engineering for different engineering materials, Surface Preparation methods such as Chemical, Electrochemical, Mechanical: Sand Blasting, Shot peening, Shot blasting, Hydro-blasting, Vapor Phase Degreasing etc., Coatings: Classification, Properties and applications of Various Coatings. |                                                                                                                                                                           |                    |  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                                                       | <b>SURFACE MODIFICATION TECHNIQUES</b>                                                                                                                                    | <b>(9 Periods)</b> |  |
| Surface modification by use of directed energy beams, Plasma, Sputtering & Ion Implantation. Surface modification by Friction stir processing. Surface composites.                                                                                                                                                                                    |                                                                                                                                                                           |                    |  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                           |                    |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                  |                                                                                                                                                                           |                    |  |

**TEXT BOOKS:**

|   |                                                                                                                                                       |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | G. Cao, “ <i>Nanostructures and Nanomaterials: Synthesis</i> ”, Properties and Applications by Imperial College Press, 2 <sup>nd</sup> edition, 2011. |
| 2 | Keith Austin “ <i>Surface Engineering Hand Book</i> ”, London : Kogan Page, 1998                                                                      |

**REFERENCES:**

|   |                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------|
| 1 | Gregory Timp, “ <i>Nanotechnology</i> ”, Springer, 2012                                                             |
| 2 | Dheerendra Kumar Dwivedi, “ <i>Surface Engineering: Enhancing Life of Tribological Components</i> ”, Springer, 2018 |
| 3 | D. Phil Woodruff, “ <i>Modern Techniques of Surface Science</i> ”, Cambridge University Press, 2016                 |
| 4 | Sulabha K. Kulkarni, “ <i>Nanotechnology: Principles and Practices</i> ”, Springer, 2019                            |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| <b>COURSE OUTCOMES:</b>                                      |                                                                                                                     | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                                     |                                        |
| CO1                                                          | Choose appropriate nano material and its manufacturing method.                                                      | K1                                     |
| CO2                                                          | Select most suitable technique to deposit a layer of nano material on ceramic surface.                              | K2                                     |
| CO3                                                          | Identify appropriate techniques to characterize nano materials.                                                     | K2                                     |
| CO4                                                          | Select surface preparation, coating techniques and predict their combinational effect for engineering applications. | K2                                     |
| CO5                                                          | Adopt different techniques to modify surfaces and make surface composites as per requirement.                       | K2                                     |

**COURSE ARTICULATION MATRIX:**

| <b>a) CO and PO Mapping</b>                         |                                                                                                                               |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| COs/POs                                             | PO 1                                                                                                                          | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
| CO1                                                 | -                                                                                                                             | 1    | 2    | 1    | 1    | -    | -    | -    | -    | -     | -     | -     | 2     | 2     | 3     |
| CO2                                                 | -                                                                                                                             | 1    | 2    | 1    | 1    | -    | -    | -    | -    | -     | -     | -     | 2     | 2     | 3     |
| CO3                                                 | -                                                                                                                             | 1    | 2    | 1    | 1    | -    | -    | -    | -    | -     | -     | -     | 2     | 2     | 3     |
| CO4                                                 | -                                                                                                                             | 2    | 2    | 1    | 1    | -    | -    | -    | -    | -     | 1     | -     | 2     | 3     | 3     |
| CO5                                                 | -                                                                                                                             | 1    | 2    | 1    | 1    | -    | -    | -    | -    | -     | 1     | -     | 3     | 2     | 3     |
| <b>22MOES03</b>                                     | -                                                                                                                             | 1    | 2    | 1    | 1    | -    | -    | -    | -    | -     | 1     | -     | 2     | 2     | 3     |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                                               |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| <b>b) CO and Key Performance Indicators Mapping</b> |                                                                                                                               |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO1                                                 | 2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2                              |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO2                                                 | 2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2                              |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO3                                                 | 2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2                              |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO4                                                 | 2.1.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2, 5.3.1, 11.3.1 |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO5                                                 | 2.2.2, 2.2.3, 2.2.4, 2.3.1, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 4.1.1, 4.3.4, 5.1.2, 5.3.1, 11.3.1               |      |      |      |      |      |      |      |      |       |       |       |       |       |       |

| <b>ASSESSMENT PATTERN – THEORY</b>                           |                    |                      |                 |                  |                   |                 |         |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 50                 | 50                   |                 |                  |                   |                 | 100     |
| CAT2                                                         | 30                 | 70                   |                 |                  |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 50                 | 50                   |                 |                  |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                 | 70                   |                 |                  |                   |                 | 100     |
| ESE                                                          | 40                 | 60                   |                 |                  |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                 |
|-----------------|-----------------------------------------------------------------|
| <b>22MOES04</b> | <b>INDUSTRIAL SAFETY MANAGEMENT</b><br>(Common to All Branches) |
|-----------------|-----------------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                    |                    |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------|--|
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | To learn the techniques of industrial safety and management to implement and solve safety problems in engineering. |                    |  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>ENVIRONMENT AND SAFETY PHILOSOPHY</b>                                                                           | <b>(9 Periods)</b> |  |
| Henrichs Axioms Of Industrial Safety - Concepts Of Safety – Ethics of environmental conservation – Environmental Impact Assessment – Environmental economics – Safety philosophy – Planning for safety – Organising for safety – Directing for safety - Role of Occupier and Factory Manager, Factory Safety Committee, Structure and Functions and Working Tenure Details                                                                                                                                                                                         |                                                                                                                    |                    |  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>SAFETY APPRAISAL AND CONTROL TECHNIQUES</b>                                                                     | <b>(9 Periods)</b> |  |
| Plant and equipment safety appraisal techniques – Laws and regulation – Hazards and Risks – Major accident hazard control – Importance of Disaster management                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                    |                    |  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>ACCIDENT PREVENTION AND SAFETY MANAGEMENT</b>                                                                   | <b>(9 Periods)</b> |  |
| Incident - Accident - Injury - Dangerous occurrence - Unsafe Act - Unsafe Conditions - Hazards - Error, Oversight - Mistake , Near Miss - Measurement of safety performance - Key elements of Safety Management system (ISO 14001, OHSAS 18001 etc.). ILO Legislations – Convention and Recommendation concerning Safety, Health and Environment – Objectives of Health, Safety and Environment Policy, Responsibility for Implementation of HSE Policy.                                                                                                           |                                                                                                                    |                    |  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>SAFETY MANAGEMENT IN INDUSTRIES</b>                                                                             | <b>(9 Periods)</b> |  |
| Safe Guarding of machines – Manual handling and storage of materials – Mechanical handling of materials – Hand tools and portable power tools – Electrical hazards – Earth , insulation and continuity tests – Industrial lighting – Safety of pressure vessels – Ventilation and heat control – Housekeeping – Special precautions - Safety in Construction Industry – Safety in Engineering Industry – Safety in Chemical Industries – Safety in Textile Industries – Safety in Dock and Port – Transportation Safety – Safety in Fire and explosive industries. |                                                                                                                    |                    |  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>INDUSTRIAL HYGIENE AND POLLUTION CONTROL</b>                                                                    | <b>(9 Periods)</b> |  |
| Industrial Hygiene – Air sampling – Noise and vibration – Industrial physiology - Occupational health – Personal Protective Equipment’s – Pollution Control strategies.                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                    |                    |  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                    |                    |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                    |                    |  |

**TEXT BOOKS:**

|   |                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Akhil Kumar Das, “ <b>Principles of Industrial Safety Management</b> ”:Understanding the Ws of <b>Safety at Work</b> ” PHI Learning , 2021 |
| 2 | Jain R K and Sunil.S.Rao, “ <b>Industrial Safety Health and Environment Management System</b> ”, Seventh reprint, Khanna publishers, 2023. |



**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| <b>ASSESSMENT PATTERN</b>                                    |                           |                             |                        |                         |                          |                        |                |
|--------------------------------------------------------------|---------------------------|-----------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------|
| <b>Test / Bloom's Category*</b>                              | <b>Remembering (K1) %</b> | <b>Understanding (K2) %</b> | <b>Applying (K3) %</b> | <b>Analyzing (K4) %</b> | <b>Evaluating (K5) %</b> | <b>Creating (K6) %</b> | <b>Total %</b> |
| CAT1                                                         | 70                        | 20                          | 10                     |                         |                          |                        | 100            |
| CAT2                                                         | 50                        | 30                          | 20                     |                         |                          |                        | 100            |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 60                        | 40                          |                        |                         |                          |                        | 100            |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 50                        | 30                          | 20                     |                         |                          |                        | 100            |
| ESE                                                          | 50                        | 30                          | 20                     |                         |                          |                        | 100            |



**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                |                                                                |          |                      |           |                   |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|----------|----------------------|-----------|-------------------|---|
| 22EOES05                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                | RENEWABLE POWER GENERATION SYSTEMS<br>(Common to All Branches) |          |                      |           |                   |   |
| PREREQUISITES                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                |                                                                | CATEGORY | L                    | T         | P                 | C |
| NIL                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                |                                                                | OE       | 3                    | 0         | 0                 | 3 |
| Course Objectives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | To understand energy scenarios, energy sources and their utilization, society’s present needs and future energy demands, the principles of renewable energy conversion systems |                                                                |          |                      |           |                   |   |
| UNIT – I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ENERGY SCENARIO                                                                                                                                                                |                                                                |          |                      | 9 Periods |                   |   |
| Principles of renewable energy; energy and sustainable development, fundamentals and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. Introduction to Internet of energy (IOE).                                                                                                                                                              |                                                                                                                                                                                |                                                                |          |                      |           |                   |   |
| UNIT – II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | SOLAR ENERGY                                                                                                                                                                   |                                                                |          |                      | 9 Periods |                   |   |
| Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder. Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant. Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.                                                               |                                                                                                                                                                                |                                                                |          |                      |           |                   |   |
| UNIT – III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | WIND AND BIOMASS ENERGY                                                                                                                                                        |                                                                |          |                      | 9 Periods |                   |   |
| Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and multi blade system. Vertical axis- Savonius and Darrieus types.<br>Biomass Energy: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies -fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft). |                                                                                                                                                                                |                                                                |          |                      |           |                   |   |
| UNIT – IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | TIDAL AND OCEAN THERMAL ENERGY                                                                                                                                                 |                                                                |          |                      | 9 Periods |                   |   |
| Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations.<br>Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world, problems associated with OTEC.                                                                                                                                                                                                                                                 |                                                                                                                                                                                |                                                                |          |                      |           |                   |   |
| UNIT – V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | GREEN ENERGY                                                                                                                                                                   |                                                                |          |                      | 9 Periods |                   |   |
| Introduction, Fuel cells: Classification of fuel cells – H <sub>2</sub> ; Operating principles, Zero energy Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.                                                                                                                                                                                                                                |                                                                                                                                                                                |                                                                |          |                      |           |                   |   |
| Contact Periods: (Times New Roman, Size 11, BOLD, Sentence case)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                |                                                                |          |                      |           |                   |   |
| Lecture: 45 Periods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                | Tutorial: 0 Periods                                            |          | Practical: 0 Periods |           | Total: 45 Periods |   |

**TEXT BOOK:**

|   |                                                                                    |
|---|------------------------------------------------------------------------------------|
| 1 | G D Rai, Non Conventional Energy sources, Khanna Publication, Fourth Edition, 2009 |
| 2 | Boyle, "Renewable Energy – Power For A Sustainable Future", Oxford, 2012           |

**REFERENCES:**

|   |                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------|
| 1 | S Rao, B.B. Parulekhar, "Energy Technology 3/e: Nonconventional, Renewable and Conventional", Khanna Publishers, 1994 |
| 2 | G. N. Tiwari, "Solar Energy - Fundamentals, Design, Modelling and Applications", 2002                                 |

|   |                                                                                  |
|---|----------------------------------------------------------------------------------|
| 3 | Gilbert M. Masters, “Renewable and Efficient Electric Power Systems” Wiley, 2005 |
| 4 | Shobh Nath Singh, “Non-Convention Energy Resources”, Pearson, 2018               |

### COURSE ARTICULATION MATRIX:

| a) CO and PO Mapping                                                            |                                                                                                                                                                                                                                                                                                                                                                   |         |         |         |         |         |         |         |         |          |          |          |          |          |          |
|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|
| COs/P<br>Os                                                                     | PO<br>1                                                                                                                                                                                                                                                                                                                                                           | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PO<br>12 | PSO<br>1 | PSO<br>2 | PSO<br>3 |
| CO1                                                                             | 3                                                                                                                                                                                                                                                                                                                                                                 | 3       | 3       | 3       | 3       | 3       | 3       | -       | -       | -        | -        | 3        | 3        | 3        | 2        |
| CO2                                                                             | 3                                                                                                                                                                                                                                                                                                                                                                 | 3       | 3       | 3       | 3       | 3       | 3       | -       | -       | -        | -        | 3        | 3        | 3        | 2        |
| CO3                                                                             | 3                                                                                                                                                                                                                                                                                                                                                                 | 3       | 3       | 3       | 3       | 3       | 3       | -       | -       | -        | -        | 3        | 3        | 3        | 2        |
| CO4                                                                             | 3                                                                                                                                                                                                                                                                                                                                                                 | 3       | 3       | 3       | 3       | 3       | 3       | -       | -       | -        | -        | 3        | 3        | 3        | 2        |
| CO5                                                                             | 3                                                                                                                                                                                                                                                                                                                                                                 | 3       | 3       | 3       | 3       | 3       | 3       | -       | -       | -        | -        | 3        | 3        | 3        | 2        |
| <b>22EOE<br/>\$05</b>                                                           | 3                                                                                                                                                                                                                                                                                                                                                                 | 3       | 3       | 3       | 3       | 3       | 3       | -       | -       | -        | -        | 3        | 3        | 3        | 2        |
| 1 – Slight, 2 – Moderate, 3 – Substantial                                       |                                                                                                                                                                                                                                                                                                                                                                   |         |         |         |         |         |         |         |         |          |          |          |          |          |          |
| <b>b) CO and Key Performance Indicators Mapping (Times New Roman, Size 11 )</b> |                                                                                                                                                                                                                                                                                                                                                                   |         |         |         |         |         |         |         |         |          |          |          |          |          |          |
| CO1                                                                             | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2. |         |         |         |         |         |         |         |         |          |          |          |          |          |          |
| CO2                                                                             | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2. |         |         |         |         |         |         |         |         |          |          |          |          |          |          |
| CO3                                                                             | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2. |         |         |         |         |         |         |         |         |          |          |          |          |          |          |

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|     |                                                                                                                                                                                                                                                                                                                                                                   |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO4 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2. |
| CO5 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.1.2,3.1.3,3.1.4,3.1.5,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.3.2,3.4.1,3.4.2,4.1.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,4.3.2,4.3.3,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,6.1.1,6.2.1,7.1.1,7.1.2,7.2.1,7.2.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.2. |

| <b>ASSESSMENT PATTERN – THEORY</b>                           |                           |                             |                        |                         |                          |                        |                |
|--------------------------------------------------------------|---------------------------|-----------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------|
| <b>Test / Bloom's Category*</b>                              | <b>Remembering (K1) %</b> | <b>Understanding (K2) %</b> | <b>Applying (K3) %</b> | <b>Analyzing (K4) %</b> | <b>Evaluating (K5) %</b> | <b>Creating (K6) %</b> | <b>Total %</b> |
| CAT1                                                         | 20                        | 20                          | 30                     | 30                      |                          |                        | 100            |
| CAT2                                                         | 20                        | 20                          | 30                     | 30                      |                          |                        | 100            |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                        | 20                          | 30                     | 30                      |                          |                        | 100            |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                        | 20                          | 30                     | 30                      |                          |                        | 100            |
| ESE                                                          | 20                        | 20                          | 30                     | 30                      |                          |                        | 100            |

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|                  |                                                          |
|------------------|----------------------------------------------------------|
| <b>22EOE\$06</b> | <b>SMART GRID TECHNOLOGY</b><br>(Common to All Branches) |
|------------------|----------------------------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>OE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                           |                                                                                                                                                                               |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                  | To provide a comprehensive understanding of Smart Grid Technology, including its components, functions, applications and implications for Energy Management and Distribution. |                  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                           | <b>BASICS OF POWER SYSTEMS</b>                                                                                                                                                | <b>9 Periods</b> |
| Basics of Power Systems: Load and Generation - Power Flow Analysis- Economic Dispatch and Unit Commitment Problems. Smart Grid: Definition – Applications- Government and Industry- Standardization                                                                                       |                                                                                                                                                                               |                  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                          | <b>SMART GRID COMMUNICATIONS</b>                                                                                                                                              | <b>9 Periods</b> |
| Two-way Digital Communications Paradigm - Network Architectures - IP-based Systems - Power Line Communications - Advanced Metering Infrastructure                                                                                                                                         |                                                                                                                                                                               |                  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                         | <b>WIDE AREA MEASUREMENT</b>                                                                                                                                                  | <b>9 Periods</b> |
| Sensor Networks - Phasor Measurement Units- Communications Infrastructure- Fault Detection and Self-Healing Systems -Applications and Challenges                                                                                                                                          |                                                                                                                                                                               |                  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                          | <b>SECURITY AND PRIVACY</b>                                                                                                                                                   | <b>9 Periods</b> |
| Cyber Security Challenges in Smart Grid - Load Altering Attacks- False Data Injection Attacks- Defense Mechanisms - Privacy Challenges- Cyber Security Standards                                                                                                                          |                                                                                                                                                                               |                  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                           | <b>ECONOMICS AND MARKET OPERATIONS</b>                                                                                                                                        | <b>9 Periods</b> |
| Introduction, Reasons for restructuring / deregulation of power industry, Understanding the restructuring process - Entities involved. The market place mechanisms-Energy and Reserve Markets- Market Power - Generation Firms- Locational Marginal Prices- Financial Transmission Rights |                                                                                                                                                                               |                  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                   |                                                                                                                                                                               |                  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                      |                                                                                                                                                                               |                  |

**TEXT BOOK :**

|   |                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage “Smart Grid Technologies and applications” John Wiley Publishers Ltd., 2012.                                                |
| 2 | P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan “Electrical Power Systems- Analysis, Security and Deregulation” PHI Learning Private Limited, New Delhi, 2012. |

**REFERENCES**

|   |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------|
| 1 | Lars T. Berger, Krzysztof Iniewski “Smart Grid applications, Communications and Security” John Wiley Publishers Ltd., 2012. |
| 2 | Yang Xiao, “Communication and Networking in Smart Grids”, CRC Press Taylor and Francis Group, 2012.                         |
| 3 | Caitlin G. Elsworth, “The Smart Grid and Electric Power Transmission”, Nova Science Publishers Inc, August 2010             |
| 4 | Lars T. Berger, Krzysztof Iniewski “Smart Grid applications, Communications and Security” John Wiley Publishers Ltd., 2012. |

## B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES:</b>                                      |                                                                                              | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|--------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                              |                                        |
| CO1                                                          | Recollect the fundamentals of conventional power systems and learn the concept of smart grid | K1                                     |
| CO2                                                          | Interpret the role of communication Technologies in a smart grid                             | K2                                     |
| CO3                                                          | Apply the state-of-the-art measurement and protection techniques for reliable grid           | K3                                     |
| CO4                                                          | Utilize the techniques for ensuring safety and security of the smart grid                    | K3                                     |
| CO5                                                          | Analyze the economical aspects of the smart grids                                            | K4                                     |

### COURSE ARTICULATION MATRIX :

| a) CO and PO Mapping                         |                                                                                                                                                                                                                                          |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
|----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| COs/POs                                      | PO 1                                                                                                                                                                                                                                     | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
| CO1                                          | 2                                                                                                                                                                                                                                        | 2    | 2    | 2    | 2    | 2    | 2    | -    | -    | 1     | 1     | -     | 3     | 2     | 1     |
| CO2                                          | 3                                                                                                                                                                                                                                        | 3    | 1    | 2    | 2    | -    | -    | -    | -    | 2     | 3     | 2     | 3     | 2     | 1     |
| CO3                                          | 3                                                                                                                                                                                                                                        | 3    | 1    | 2    | 2    | -    | -    | -    | -    | 2     | 3     | 2     | 3     | 3     | 2     |
| CO4                                          | 3                                                                                                                                                                                                                                        | 3    | 1    | 2    | 2    | 3    | 2    | 2    | 1    | -     | -     | 3     | 3     | 3     | 2     |
| CO5                                          | 3                                                                                                                                                                                                                                        | 2    | 2    | 2    | 2    | -    | 2    | 2    | -    | 1     | 3     | 3     | 3     | 3     | 2     |
| 22EOES06                                     | 3                                                                                                                                                                                                                                        | 3    | 1    | 2    | 2    | 3    | 2    | 2    | 1    | 2     | 3     | 3     | 3     | 3     | 2     |
| 1 – Slight, 2 – Moderate, 3 – Substantial    |                                                                                                                                                                                                                                          |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| b) CO and Key Performance Indicators Mapping |                                                                                                                                                                                                                                          |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO1                                          | 1.2.1,1.3.1,1.4.1,2.3.1,2.3.2,2.4.4,3.1.3,3.1.6,3.2.1,4.1.4,4.2.1,4.3.4,5.1.1,5.3.1,6.1.1,7.1.1,7.2.2,10.1.1,10.3.1,11.1.1                                                                                                               |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO2                                          | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2,10.1.1,10.2.2,10.3.1,11.1.1,11.2.1,11.3.1,11.3.2,12.3.1,12.3.2 |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO3                                          | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2,10.1.1,10.2.2,10.3.1,11.1.1,11.2.1,11.3.1,11.3.2,12.3.1,12.3.2 |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO4                                          | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,8.2.2,9.1.2,7.2.1,7.2.2,6.2.1,6.1.1,5.3.2,5.3.1,5.3.2,12.1.2,12.2.2,12.3.2,         |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO5                                          | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,12.1.2,12.2.2,12.3.2                                                                |      |      |      |      |      |      |      |      |       |       |       |       |       |       |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| ASSESSMENT PATTERN                                           |                    |                      |                 |                  |                   |                 |         |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 10                 | 30                   | 40              | 20               |                   |                 | 100     |
| CAT2                                                         | 10                 | 30                   | 40              | 20               |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                    | 30                   | 30              | 20               | 20                |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                    | 30                   | 30              | 20               | 20                |                 | 100     |
| ESE                                                          | 10                 | 30                   | 40              | 20               |                   |                 | 100     |



|                 |                                                     |
|-----------------|-----------------------------------------------------|
| <b>22LOES07</b> | <b>CMOS VLSI DESIGN</b><br>(Common to All Branches) |
|-----------------|-----------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                           |                                                                                                                                 |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>Course Objective</b>                                                                                                                                                                                                                                                                   | To introduce various aspects of CMOS logic design in combinational and sequential circuit to design CMOS VLSI system components |                  |  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                           | <b>CMOS LOGIC DESIGN</b>                                                                                                        | <b>9 Periods</b> |  |
| Inverter- CMOS Logic Gates: Compound Gates – Pass Transistors and Transmission Gates – Tristated – Multiplexers – CMOS Fabrication and Layout: Fabrication Process – Layout Design rule – Gate Layouts – Stick Diagrams – Design Partitioning.                                            |                                                                                                                                 |                  |  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                          | <b>MOS TRANSISTOR THEORY</b>                                                                                                    | <b>9 Periods</b> |  |
| Introduction – Long Channel I-V Characteristics – C-V Characteristics – Non-ideal I-V Effects – DC Transfer Characteristics – CMOS Technologies – Sources of Power Dissipation - Dynamic Power – Static Power.                                                                            |                                                                                                                                 |                  |  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                         | <b>COMBINATIONAL CIRCUIT DESIGN</b>                                                                                             | <b>9 Periods</b> |  |
| Circuit Families: Static CMOS – Ratioed Circuits – Cascode Voltage Switch Logic – Dynamic Circuits – Pass Transistor Circuits. Silicon-on-Insulator Circuit Design – Subthreshold Circuit Design.                                                                                         |                                                                                                                                 |                  |  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                          | <b>SEQUENTIAL CIRCUIT DESIGN</b>                                                                                                | <b>9 Periods</b> |  |
| Sequential static circuits – Circuit design of latched and flip-flops – Sequencing dynamic circuits – Synchronizers – Wave pipelining – VLSI clocking: CMOS clocking styles – Pipelined systems – Clock generation and distribution.                                                      |                                                                                                                                 |                  |  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                           | <b>DESIGN OF VLSI SYSTEMS</b>                                                                                                   | <b>9 Periods</b> |  |
| System Specifications – Structural Gate Level Modeling – Switch Level Modeling – Behavioral and RTL Modeling – Addition/subtraction – Comparators – counters – Multiplexers – Binary Decoders – Comparators – Priority Encoders – Latches - Flip-Flops and Registers – SRAM – DRAM – ROM. |                                                                                                                                 |                  |  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                   |                                                                                                                                 |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                      |                                                                                                                                 |                  |  |

**TEXT BOOKS:**

|   |                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------|
| 1 | N. Weste and David Money Harris, "CMOS VLSI Design", Fourth Edition, Pearson Education, 2011             |
| 2 | Uyemura, John P, "Introduction to VLSI Circuits and Systems", Wiley & Sons, 8 <sup>th</sup> Reprint 2009 |

**REFERENCES:**

|   |                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------|
| 1 | Jan M. Rabaey, "Digital Integrated Circuits: A Design Perspective", PHI, Second Edition, 2012.            |
| 2 | R. Jacob Baker, "CMOS: Circuit Design, Layout, and Simulation", Wiley-IEEE, Revised Second Edition, 2008. |
| 3 | Pucknell, "Basic VLSI Design", Prentice Hall, 2006.                                                       |

| <b>COURSE OUTCOMES:</b><br>Upon completion of the course, the students will be able to: |                                                                              | <b>Bloom's Taxonomy Mapped</b> |
|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------------------|
| CO1                                                                                     | Realize the CMOS logic design                                                | K2                             |
| CO2                                                                                     | Explain the basic MOS transistor theory and power dissipation in CMOS logic. | K2                             |
| CO3                                                                                     | Develop combinational circuit design of CMOS logic                           | K3                             |
| CO4                                                                                     | Interpret sequential circuit design of CMOS logic                            | K2                             |
| CO5                                                                                     | Model the digital system using Hardware Description Language                 | K2                             |

**COURSE ARTICULATION MATRIX :**

| <b>a) CO and PO Mapping</b>                         |                                                                                                                                                                                                                           |          |          |     |     |          |     |     |     |          |       |          |          |          |          |
|-----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|-----|-----|----------|-----|-----|-----|----------|-------|----------|----------|----------|----------|
| COs/POs                                             | PO 1                                                                                                                                                                                                                      | PO 2     | PO3      | PO4 | PO5 | PO6      | PO7 | PO8 | PO9 | PO 10    | PO 11 | PO 12    | PSO1     | PSO2     | PSO3     |
| CO1                                                 | 3                                                                                                                                                                                                                         | 3        | 2        | -   | -   | 2        | -   | -   | -   | 2        | -     | 3        | 3        | 1        | 3        |
| CO2                                                 | 3                                                                                                                                                                                                                         | 2        | 1        | -   | -   | 2        | -   | -   | -   | 2        | -     | 3        | 2        | 1        | 2        |
| CO3                                                 | 3                                                                                                                                                                                                                         | 3        | 2        | -   | -   | 2        | -   | -   | -   | 2        | -     | 3        | 3        | 1        | 3        |
| CO4                                                 | 3                                                                                                                                                                                                                         | 3        | 2        | -   | -   | 2        | -   | -   | -   | 2        | -     | 3        | 3        | 1        | 3        |
| CO5                                                 | 3                                                                                                                                                                                                                         | 3        | 2        | -   | -   | 2        | -   | -   | -   | 2        | -     | 3        | 3        | 1        | 3        |
| <b>22LOES07</b>                                     | <b>3</b>                                                                                                                                                                                                                  | <b>3</b> | <b>2</b> | -   | -   | <b>2</b> | -   | -   | -   | <b>2</b> | -     | <b>3</b> | <b>3</b> | <b>1</b> | <b>3</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                                                                                                                                                           |          |          |     |     |          |     |     |     |          |       |          |          |          |          |
| <b>b) CO and Key Performance Indicators Mapping</b> |                                                                                                                                                                                                                           |          |          |     |     |          |     |     |     |          |       |          |          |          |          |
| CO1                                                 | 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |          |          |     |     |          |     |     |     |          |       |          |          |          |          |
| CO2                                                 | 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2                             |          |          |     |     |          |     |     |     |          |       |          |          |          |          |
| CO3                                                 | 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2        |          |          |     |     |          |     |     |     |          |       |          |          |          |          |
| CO4                                                 | 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 2.4.3, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |          |          |     |     |          |     |     |     |          |       |          |          |          |          |
| CO5                                                 | 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 2.4.1, 3.1.4, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 6.1.1, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2        |          |          |     |     |          |     |     |     |          |       |          |          |          |          |

| <b>ASSESSMENT PATTERN – THEORY</b>                           |                    |                      |                 |                  |                   |                 |         |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 40                 | 40                   | 20              |                  |                   |                 | 100     |
| CAT2                                                         | 40                 | 40                   | 20              |                  |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  |                    | 50                   | 50              |                  |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 |                    | 50                   | 50              |                  |                   |                 | 100     |
| ESE                                                          | 40                 | 40                   | 20              |                  |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                         |
|-----------------|---------------------------------------------------------|
| <b>22LOES08</b> | <b>MOBILE COMMUNICATION</b><br>(Common to All Branches) |
|-----------------|---------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                             |                  |  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                                                                                                 | To understand and recall the mobile radio propagation, cellular architectures, equalization and diversity techniques, digital modulation techniques and various wireless network standards. |                  |  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                                                                                         | <b>MOBILE RADIO PROPAGATION</b>                                                                                                                                                             | <b>9 Periods</b> |  |
| Review of free-space propagation - Radio Wave Propagation in wireless environment - Free Space Propagation Model - Ground Reflection Model, Diffraction, Scattering - Practical link budget design - Small scale fading - Time dispersion parameters - Coherence bandwidth - Doppler spread & Coherence time, Fading due to Multipath time delay spread - Fading due to Doppler spread. |                                                                                                                                                                                             |                  |  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                                                                                        | <b>CELLULAR CONCEPT</b>                                                                                                                                                                     | <b>9 Periods</b> |  |
| Hexagonal cell-Cell clustering-Frequency Reuse-Static and dynamic channel assignment strategies - Handoff Strategies - Interference and System Capacity - Trunking - Capacity in Cellular Systems. Multiple Access Techniques: FDMA, TDMA, CDMA, OFDMA.                                                                                                                                 |                                                                                                                                                                                             |                  |  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                                                                                                       | <b>MULTIPATH MITIGATION TECHNIQUES</b>                                                                                                                                                      | <b>9 Periods</b> |  |
| Equalization – Adaptive equalization: Linear and Non-Linear equalization, - Diversity – Micro and Macro diversity - Diversity combining techniques - Rake receiver- MIMO Coding: Alamouti Scheme (Qualitative)                                                                                                                                                                          |                                                                                                                                                                                             |                  |  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                                                                                                        | <b>MODULATION TECHNIQUES</b>                                                                                                                                                                | <b>9 Periods</b> |  |
| Modulation in cellular wireless systems: Binary Phase Shift Keying (BPSK) – QPSK –Orthogonal QPSK- Minimum Shift Keying-Gaussian Minimum Shift Keying - Multicarrier modulation: Orthogonal Frequency Division Multiplexing (OFDM) -PAPR reduction –Windowed OFDM - Filtered OFDM                                                                                                       |                                                                                                                                                                                             |                  |  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                                                                                         | <b>WIRELESS NETWORKS</b>                                                                                                                                                                    | <b>9 Periods</b> |  |
| Second Generation Cellular Standard: GSM - Third Generation Cellular standards: CDMA -WCDMA- Fourth Generation Cellular Standards: 4G LTE – LTE Advanced – 5G Network – Near Field Communication (NFC) systems – Wireless LAN technology – Hyper LAN – Bluetooth technology – Ultra Wideband (UWB) communication - Introduction to 60 GHz mmWave.                                       |                                                                                                                                                                                             |                  |  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                             |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                             |                  |  |

**TEXT BOOKS:**

|   |                                                                                                              |
|---|--------------------------------------------------------------------------------------------------------------|
| 1 | Theodore S. Rappaport, "Wireless communications", 2 <sup>nd</sup> Edition, Pearson Education, 2010           |
| 2 | Mischa Schwartz, "Mobile Wireless Communications", 1 <sup>st</sup> Edition, Cambridge University Press, 2010 |

**REFERENCES:**

|   |                                                                                                                                                                               |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Suvra Sekhar Das and Ramjee Prasad, "Evolution of air interface towards 5G Radio Access Technology and Performance Analysis", River Publishers,2018                           |
| 2 | David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication", 1 <sup>st</sup> Edition, Cambridge University Press, 2006.                                             |
| 3 | Andreas.F. Molisch, "Wireless Communications", 2 <sup>nd</sup> Edition, Wiley, 2011.                                                                                          |
| 4 | Aditya K Jagannatham, "Principles of Modern Wireless Communication Systems Theory and Practice", 1 <sup>st</sup> Edition, McGraw Hill Education (India) Private Limited, 2017 |
| 5 | William Stallings, "Wireless Communications and networks", 2 <sup>nd</sup> Edition, Pearson, 2009.                                                                            |

**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**

| <b>COURSE OUTCOMES:</b><br>Upon completion of the course, the students will be able to: |                                                                                                                                                                             | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                     | Interpret the concepts of radio propagation and fading channel models in wireless communication                                                                             | K3                                     |
| CO2                                                                                     | Interpret the functionalities of various cellular concepts and multiple access techniques and solve problems in channel assignment and traffic intensity in cellular system | K4                                     |
| CO3                                                                                     | Explain various equalization and diversity combining techniques used in multipath propagation                                                                               | K2                                     |
| CO4                                                                                     | Discuss the need for digital and multicarrier modulation techniques used in modern cellular system                                                                          | K2                                     |
| CO5                                                                                     | Recall the functionalities of various wireless networks used in day-today life.                                                                                             | K2                                     |

**COURSE ARTICULATION MATRIX:**

**a) CO and PO Mapping**

| COs/<br>POs       | PO<br>1 | PO<br>2 | PO<br>3 | PO<br>4 | PO<br>5 | PO<br>6 | PO<br>7 | PO<br>8 | PO<br>9 | PO<br>10 | PO<br>11 | PO<br>12 | PS<br>O1 | PS<br>O2 | PS<br>O3 |
|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|----------|----------|
| CO1               | 3       | 2       | 1       | 1       | -       | -       | -       | -       | -       | -        | -        | 1        | 3        | -        | 1        |
| CO2               | 3       | 2       | 1       | 1       | -       | -       | -       | -       | -       | -        | -        | 1        | 3        | -        | 1        |
| CO3               | 3       | 2       | 1       | 1       | -       | -       | -       | -       | -       | -        | -        | 1        | 3        | -        | 1        |
| CO4               | 3       | 2       | 1       | 1       | -       | -       | -       | -       | -       | -        | -        | 1        | 3        | -        | 1        |
| CO5               | 3       | 2       | 1       | 1       | -       | -       | -       | -       | -       | -        | -        | 1        | 3        | -        | 1        |
| <b>22LOES\$08</b> | 3       | 2       | 1       | 1       | -       | -       | -       | -       | -       | -        | -        | 1        | 3        | -        | 1        |

1 – Slight, 2 – Moderate, 3 – Substantial

**b) CO and Key Performance Indicators Mapping**

|     |                                                                                                                                        |
|-----|----------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2 |
| CO2 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2 |
| CO3 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3, 12.1.1,12.2.2 |
| CO4 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3,12.1.1,12.2.2  |
| CO5 | 1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.3.1,2.3.2,2.4.1,2.4.4,3.1.1,3.1.2,3.3.1,4.1.1,4.2.1,4.3.3,12.1.1,12.2.2  |

**ASSESSMENT PATTERN – THEORY**

| Test / Bloom's<br>Category*                                           | Remembering<br>(K1) % | Understanding<br>(K2) % | Applying<br>(K3) % | Analyzing<br>(K4) % | Evaluating<br>(K5) % | Creating<br>(K6) % | Total<br>% |
|-----------------------------------------------------------------------|-----------------------|-------------------------|--------------------|---------------------|----------------------|--------------------|------------|
| CAT1                                                                  | 20                    | 40                      | 20                 | 20                  |                      |                    | 100        |
| CAT2                                                                  | 50                    | 50                      |                    |                     |                      |                    | 100        |
| Individual<br>Assessment 1 /Case<br>Study 1/ Seminar 1 /<br>Project1  | 20                    | 40                      | 20                 | 20                  |                      |                    | 100        |
| Individual<br>Assessment 2 /Case<br>Study 2/ Seminar 2 /<br>Project 2 | 50                    | 50                      |                    |                     |                      |                    | 100        |
| ESE                                                                   | 20                    | 40                      | 20                 | 20                  |                      |                    | 100        |

|                 |                                                     |
|-----------------|-----------------------------------------------------|
| <b>22POES09</b> | <b>RAPIDPROTOTYPING</b><br>(Common to All Branches) |
|-----------------|-----------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                |             |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|--|
| Course Objective                                                                                                                                                                                                                                                                                                                            | To educate the students with fundamental and advanced knowledge in the field of Rapid Prototyping technology and associated Aerospace, Architecture, Art, Medical and Industrial applications. |             |  |
| UNIT- I                                                                                                                                                                                                                                                                                                                                     | INTRODUCTION                                                                                                                                                                                   | (9 Periods) |  |
| Overview - Need - Development of Rapid Prototyping (RP) Technology: Rapid Prototyping -Rapid Tooling - Rapid Manufacturing - Additive Manufacturing. RP Process Chain, Benefits, Applications: Building Printing, Bio Printing, Food Printing, Electronics Printing, Automobile, Aerospace, Healthcare.                                     |                                                                                                                                                                                                |             |  |
| UNIT- II                                                                                                                                                                                                                                                                                                                                    | VAT POLYMERIZATION AND MATERIAL EXTRUSION                                                                                                                                                      | (9 Periods) |  |
| Photo polymerization: Stereo lithography Apparatus (SLA) - Materials -Process - top down and bottom up approach - Advantages - Limitations - Applications. Digital Light Processing (DLP) - Process - Advantages - Applications. Material Extrusion: Fused Deposition Modelling (FDM) - Process-Materials -Applications and Limitations.    |                                                                                                                                                                                                |             |  |
| UNIT- III                                                                                                                                                                                                                                                                                                                                   | POWDER BED FUSION AND BINDER JETTING                                                                                                                                                           | (9 Periods) |  |
| Powder Bed Fusion: Selective Laser Sintering (SLS): Process - Powder Fusion Mechanism - Materials and Application. Selective Laser Melting (SLM), Electron Beam Melting (EBM): Materials - Process - Advantages and Applications. Binder Jetting: Three-Dimensional Printing - Materials - Process - Benefits - Limitations - Applications. |                                                                                                                                                                                                |             |  |
| UNIT- IV                                                                                                                                                                                                                                                                                                                                    | MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION                                                                                                                                                | (9 Periods) |  |
| Material Jetting: Multi jet Modelling- Materials - Process - Benefits - Applications. Directed Energy Deposition: Laser Engineered Net Shaping (LENS) - Process - Material Delivery -Materials –Benefits - Applications.                                                                                                                    |                                                                                                                                                                                                |             |  |
| UNIT- V                                                                                                                                                                                                                                                                                                                                     | SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY                                                                                                                                                   | (9 Periods) |  |
| Sheet Lamination: Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding - Thermal Bonding - Materials - Application and Limitation. Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.                                          |                                                                                                                                                                                                |             |  |
| Contact Periods:<br>Lecture: 45 Periods                  Tutorial: 0 Periods          Practical: 0 Periods          Total: 45 Periods                                                                                                                                                                                                       |                                                                                                                                                                                                |             |  |

**TEXT BOOK:**

|   |                                                                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani “ <i>Additive manufacturing technologies</i> ”. 3rd edition Springer Cham, Switzerland, 2021.              |
| 2 | Andreas Gebhardt and Jan-Steffen Hötter “ <i>Additive Manufacturing: 3D Printing for Prototyping and Manufacturing</i> ”, Hanser publications, United States, 2015. |

**REFERENCES:**

|   |                                                                                                                                                                 |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Andreas Gebhardt, “ <i>Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing</i> ”, Hanser Gardner Publication, Cincinnati., Ohio, 2011. |
| 2 | Milan Brandt, “ <i>Laser Additive Manufacturing: Materials, Design, Technologies, and</i>                                                                       |

|   |                                                                                                                                                                   |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <i><b>Applications”</b>, Woodhead Publishing., United Kingdom, 2016.</i>                                                                                          |
| 3 | <i>Amit Bandyopadhyay and Susmita Bose, “<b>Additive Manufacturing</b>”, 1st Edition, CRC Press., United States, 2015.</i>                                        |
| 4 | <i>Kamrani A.K. and Nasr E.A., “<b>Rapid Prototyping: Theory and practice</b>”, Springer., United States ,2006.</i>                                               |
| 5 | <i>Liou, L.W. and Liou, F.W., “<b>Rapid Prototyping and Engineering applications: A tool box for prototype development</b>”, CRC Press., United States, 2011.</i> |

| <b>COURSE OUTCOMES:</b>                                      |                                                                                                                                 | <b>Bloom's Taxonomy Mapped</b> |
|--------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                                                 |                                |
| CO1                                                          | Discuss the development of RP technology and how RP technology propagated into various businesses and developing opportunities. | K3                             |
| CO2                                                          | Demonstrate the Vat polymerization and material extrusion processes and its applications.                                       | K3                             |
| CO3                                                          | Elaborate the process and applications of powder bed fusion and binder jetting.                                                 | K3                             |
| CO4                                                          | Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.                | K3                             |
| CO5                                                          | Describe the sheet lamination and direct write technology.                                                                      | K3                             |

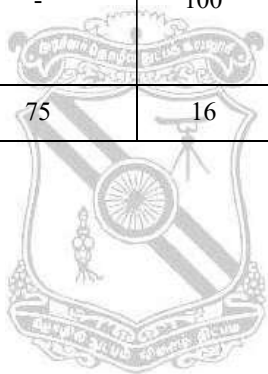
**COURSE ARTICULATION MATRIX:**

| a) CO and PO Mapping                         |                                                                                                                                                                                                                                                                                                                                                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                      | PO 1                                                                                                                                                                                                                                                                                                                                                                                                  | PO 2     | PO 3     | PO 4     | PO 5     | PO 6     | PO 7     | PO 8     | PO 9     | PO 10    | PO 11    | PO 12    | PSO1     | PSO2     | PSO3     |
| CO1                                          | 2                                                                                                                                                                                                                                                                                                                                                                                                     | 2        | 2        | -        | 2        | -        | 3        | -        | 3        | 3        | 3        | 3        | -        | -        | -        |
| CO2                                          | 2                                                                                                                                                                                                                                                                                                                                                                                                     | 2        | 3        | 2        | 3        | -        | 3        | -        | 3        | 3        | 1        | 2        | -        | -        | -        |
| CO3                                          | 2                                                                                                                                                                                                                                                                                                                                                                                                     | 2        | 3        | 2        | 3        | -        | 3        | -        | 3        | 3        | 1        | 2        | -        | -        | -        |
| CO4                                          | 2                                                                                                                                                                                                                                                                                                                                                                                                     | 2        | 3        | 2        | 3        | -        | 3        | -        | 3        | 3        | 1        | 2        | -        | -        | -        |
| CO5                                          | 2                                                                                                                                                                                                                                                                                                                                                                                                     | 2        | 3        | 2        | 3        | 3        | 3        | -        | 3        | 3        | 1        | 3        | -        | -        | -        |
| <b>22POES09</b>                              | <b>2</b>                                                                                                                                                                                                                                                                                                                                                                                              | <b>2</b> | <b>3</b> | <b>2</b> | <b>3</b> | <b>1</b> | <b>3</b> | <b>-</b> | <b>3</b> | <b>3</b> | <b>2</b> | <b>3</b> | <b>-</b> | <b>-</b> | <b>-</b> |
| 1 – Slight, 2 – Moderate, 3 – Substantial    |                                                                                                                                                                                                                                                                                                                                                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| b) CO and Key Performance Indicators Mapping |                                                                                                                                                                                                                                                                                                                                                                                                       |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 5.2.2, 5.3.1, 5.3.2, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1, 11.3.1, 11.3.2, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2.                                                    |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2. |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2. |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2. |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|     |                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO5 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.2, 3.2.3, 3.3.2, 3.4.1, 3.4.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.3.1, 12.1.1, 12.1.2, 12.2.2, 12.3.1, 12.3.2. |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| ASSESSMENT PATTERN– THEORY                                   |                    |                      |                 |                  |                   |                 |         |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 15                 | 52                   | 33              | -                | -                 | -               | 100     |
| CAT2                                                         | 15                 | 68                   | 17              | -                | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | -                  | 50                   | 50              | -                | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | -                  | -                    | 100             | -                | -                 | -               | 100     |
| ESE                                                          | 9                  | 75                   | 16              | -                | -                 | -               | 100     |



|                 |                                                        |
|-----------------|--------------------------------------------------------|
| <b>22POES10</b> | <b>MANAGERIALECONOMICS</b><br>(Common to All Branches) |
|-----------------|--------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                    |             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------|
| Course Objective                                                                                                                                                                                                                                                                                                                                                                                                                     | To introduce the fundamental economic principles necessary for production managers |             |
| UNIT- I                                                                                                                                                                                                                                                                                                                                                                                                                              | FUNDAMENTALS OF MANAGERIAL ECONOMICS                                               | (9 Periods) |
| Introduction to Economics - Scope of Managerial Economics - General Foundations of Managerial Economics: Economic Approach, Working of Economic System and Circular Flow of Activities - Economics and Business Decisions: Relationship between Economic Theory and Managerial Economics - Role of managerial Economics in Decision making - Concept of Economic Rationality - Opportunity Cost - Marginal and Incremental approach. |                                                                                    |             |
| UNIT- II                                                                                                                                                                                                                                                                                                                                                                                                                             | DEMAND ANALYSIS                                                                    | (9 Periods) |
| Demand and Supply - Determinants of Demand - Demand Estimation and Forecasting - Price Elasticity of Demand - Price Elasticity- Factors Affecting Price Elasticity - Cross Price Elasticity - Income Elasticity of Demand - Advertisement or Promotional Elasticity - Elasticity of Supply.                                                                                                                                          |                                                                                    |             |
| UNIT- III                                                                                                                                                                                                                                                                                                                                                                                                                            | DEMAND THEORY                                                                      | (9 Periods) |
| Utility Analysis - Total and Marginal Utility - Law of Diminishing marginal utility - Indifference curve analysis - Consumer Equilibrium - Consumer Surplus - Price effect, Substitution Effect and Income Effect.                                                                                                                                                                                                                   |                                                                                    |             |
| UNIT- IV                                                                                                                                                                                                                                                                                                                                                                                                                             | THEORY OF PRODUCTION AND COST                                                      | (9 Periods) |
| The Production Function - Profit-Maximizing Input Usage - Isoquants and Isocosts – CostMinimization and Optimal Input Substitution - The Cost Function - Breakeven analysis,Contribution analysis - Long-run Costs and Economies of Scale - Multiple Cost Functions andEconomies of Scope - Learning curve.                                                                                                                          |                                                                                    |             |
| UNIT- V                                                                                                                                                                                                                                                                                                                                                                                                                              | THEORY OF MARKET AND PRICING                                                       | (9 Periods) |
| Forms of Markets: Meaning and Characteristics - Market Equilibrium: Practical Importance, Market Equilibrium and Changes in Market Equilibrium. Pricing Functions: Market Structures - Pricing and output decisions under different competitive conditions: Monopoly Monopolistic completion and Oligopoly.                                                                                                                          |                                                                                    |             |
| <b>Contact Periods:</b><br>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods                                                                                                                                                                                                                                                                                                             |                                                                                    |             |

**TEXT BOOK:**

|   |                                                                                              |
|---|----------------------------------------------------------------------------------------------|
| 1 | <i>Maheshwari.Y “Managerial Economics”, Prentice Hall of India, 2012</i>                     |
| 2 | <i>Thomas and Maurice “Managerial Economics: Concept and Applications”, McGrawHill, 2005</i> |

**REFERENCES:**

|   |                                                                                           |
|---|-------------------------------------------------------------------------------------------|
| 1 | <i>D.N. Dwivedi, “Managerial Economics”, Vikas Publishing house, 2015</i>                 |
| 2 | <i>Christopher R Thomas, S Charles Maurice, “Managerial economics”, Mcgraw Hill, 2014</i> |
| 3 | <i>M. A. Beg, “Managerial Economics”, Global Professional Publishing Ltd, 2010</i>        |
| 4 | <i>K.C. Sankaranarayanan, "Managerial Economics", CBS, 2015</i>                           |

| <b>COURSE OUTCOMES:</b>                                      |                                                        | <b>Bloom's Taxonomy Mapped</b> |
|--------------------------------------------------------------|--------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to: |                                                        |                                |
| CO1                                                          | Explain fundamentals of managerial economics           | K2                             |
| CO2                                                          | Discuss the dynamics of Demand                         | K3                             |
| CO3                                                          | Explain about various theories of demand               | K3                             |
| CO4                                                          | Discuss about the factors influencing production       | K4                             |
| CO5                                                          | Describe about the theory of market and pricing method | K4                             |

**COURSE ARTICULATION MATRIX:**

| a) CO and PO Mapping                         |                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| COs/POs                                      | PO 1                                                                                                                                                                                                                                                                                                                                                                                                                                       | PO 2     | PO 3     | PO 4     | PO 5     | PO 6     | PO 7     | PO 8     | PO 9     | PO 10    | PO 11    | PO 12    | PSO1     | PSO2     | PSO3     |
| CO1                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                          | 2        | 1        | 3        | 1        | 3        | 3        | -        | 1        | 3        | 3        | 3        | -        | 1        | 2        |
| CO2                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3        | 2        | 3        | 1        | 3        | 3        | -        | 1        | 3        | 3        | 3        | -        | 1        | 2        |
| CO3                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3        | 2        | 3        | 1        | 3        | 3        | -        | 1        | 3        | 3        | 3        | -        | 1        | 2        |
| CO4                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3        | 2        | 3        | 1        | 3        | 3        | -        | 1        | 3        | 3        | 3        | 1        | 1        | 2        |
| CO5                                          | 1                                                                                                                                                                                                                                                                                                                                                                                                                                          | 3        | 2        | 3        | 1        | 3        | 3        | -        | 1        | 3        | 3        | 3        | -        | 1        | 2        |
| <b>22POES10</b>                              | <b>1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>3</b> | <b>2</b> | <b>3</b> | <b>1</b> | <b>3</b> | <b>3</b> | <b>-</b> | <b>1</b> | <b>3</b> | <b>3</b> | <b>3</b> | <b>-</b> | <b>1</b> | <b>2</b> |
|                                              | 1 – Slight, 2 – Moderate, 3 – Substantial                                                                                                                                                                                                                                                                                                                                                                                                  |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| b) CO and Key Performance Indicators Mapping |                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO1                                          | 1.2.1, 2.1.2, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.4.4, 3.1.1, 3.1.3, 3.1.5, 3.2.3, 3.3.1, 3.4.1, 4.1.1, 4.1.2, 4.3.4, 5.2.1, 5.3.1, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 10.1.1, 10.1.2, 10.1.3, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2                                                                                                                              |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO2                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO3                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO4                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
| CO5                                          | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.2, 2.4.3, 2.4.4, 3.1.1, 3.1.2, 3.1.3, 3.1.4, 3.1.5, 3.1.6, 3.2.3, 3.3.2, 3.4.1, 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.3.1, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.1, 7.1.2, 7.2.1, 7.2.2, 9.2.1, 9.3.1, 10.1.1, 10.1.2, 10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.2.1, 11.3.1, 12.1.1, 12.1.2, 12.2.1, 12.2.2, 12.3.1, 12.3.2 |          |          |          |          |          |          |          |          |          |          |          |          |          |          |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>ASSESSMENT PATTERN– THEORY</b>                            |                           |                             |                        |                         |                          |                        |                |
|--------------------------------------------------------------|---------------------------|-----------------------------|------------------------|-------------------------|--------------------------|------------------------|----------------|
| <b>Test / Bloom's Category*</b>                              | <b>Remembering (K1) %</b> | <b>Understanding (K2) %</b> | <b>Applying (K3) %</b> | <b>Analyzing (K4) %</b> | <b>Evaluating (K5) %</b> | <b>Creating (K6) %</b> | <b>Total %</b> |
| CAT1                                                         | 50                        | 50                          |                        | -                       | -                        | -                      | 100            |
| CAT2                                                         | 50                        | 50                          |                        | -                       | -                        | -                      | 100            |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 33.33                     | 33.33                       | 33.33                  | -                       | -                        | -                      | 100            |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 33.33                     | 33.33                       | 33.33                  | -                       | -                        | -                      | 100            |
| ESE                                                          | 42                        | 42                          | 16                     | -                       | -                        | -                      | 100            |



|          |                                                            |
|----------|------------------------------------------------------------|
| 22NOES11 | <b>MEASUREMENT AND CONTROL</b><br>(Common to All Branches) |
|----------|------------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                          |                  |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                         | To teach about the concepts of variable sensors for industrial parameter measurement and to impart knowledge on automatic control system |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                 | <b>INTRODUCTION TO MEASUREMENTS</b>                                                                                                      | <b>9 Periods</b> |  |
| Elements of measurement system - Classification of Instruments – Static and dynamic characteristics of a measurement system - Errors in measurement - Calibration of instruments.                                                                                                                                               |                                                                                                                                          |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                | <b>STRAIN AND DISPLACEMENT MEASUREMENT</b>                                                                                               | <b>9 Periods</b> |  |
| Strain: Types of strain gauges, theory of operation, strain gauge materials, strain gauge circuits and applications. Displacement: Resistive potentiometer: Linear, circular and helical – LVDT - RVDT - Capacitance transducers – Piezoelectric transducers – Hall Effect devices - Proximity sensors.                         |                                                                                                                                          |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                               | <b>PRESSURE AND TEMPERATURE MEASUREMENT</b>                                                                                              | <b>9 Periods</b> |  |
| Pressure: Mechanical devices: Diaphragm, bellows, and bourdon tube - Electrical devices: Variable resistance, inductance and capacitance transducers. Temperature: Resistance type temperature sensors: RTD , Thermocouples, Thermopiles and Thermistor - Laws of thermocouple – Radiation methods for temperature measurement. |                                                                                                                                          |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                                                | <b>FLOW AND LEVEL MEASUREMENT</b>                                                                                                        | <b>9 Periods</b> |  |
| Flow: Variable head type flow meters: Orifice plate, Venturi tube, Flow nozzle, Pitot tube - Variable area type: Rotameter - Turbine flow meter - Electromagnetic flow meter - Ultrasonic flow meter. Level: Resistive, inductive and capacitive techniques – Ultrasonic methods – Air purge system .                           |                                                                                                                                          |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                                                 | <b>AUTOMATIC CONTROL SYSTEM</b>                                                                                                          | <b>9 Periods</b> |  |
| Elements of control system – Concept of open loop and closed loop systems – Mathematical modelling - Controllers – Brief idea of Proportional, Derivative and Integral Modes – Pneumatic Controller – Hydraulic Controller.                                                                                                     |                                                                                                                                          |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                                                              |                                                                                                                                          |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                            |                                                                                                                                          |                  |  |

#### TEXT BOOKS:

|   |                                                                                                                           |
|---|---------------------------------------------------------------------------------------------------------------------------|
| 1 | A.K. Sawhney, Puneet Sawhney, “A Course in Mechanical Measurements and Instrumentation & Control” Dhanpat Rai & Co, 2012. |
| 2 | S. K. Singh, “Industrial Instrumentation and Control”, McGraw Hill Publication, 3 <sup>rd</sup> Edition, 2016.            |

#### REFERENCES:

|   |                                                                                                                                       |
|---|---------------------------------------------------------------------------------------------------------------------------------------|
| 1 | William Bolton, “Instrumentation and Control Systems,” Newnes, Publication, 3 <sup>rd</sup> Edition, 2021.                            |
| 2 | E. D. Doebelin, “Measurement Systems: Application and Design”, McGraw Hill Publication, 6 <sup>th</sup> Edition, 2017.                |
| 3 | E.W. Golding and F.C. Widdis, “Electrical Measurements and Measuring Instruments” A.H.Wheeler and Co., 5 <sup>th</sup> Edition, 2011. |
| 4 | Alan S. Morris, “Measurement and Instrumentation Principles”, Butterworth-Heinemann Publications, 3 <sup>rd</sup> Edition, 2011.      |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b><br>Upon Completion of the course, the students will be able to |                                                                                               | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                   | Describe the methods of measurement and classification of measuring instruments.              | K2                                     |
| CO2                                                                                   | Suggest suitable sensor for the measurement of strain and displacement.                       | K2                                     |
| CO3                                                                                   | Explain the construction and working of transducers for pressure and temperature measurement. | K2                                     |
| CO4                                                                                   | Elucidate the characteristics of flow and level measuring instruments.                        | K2                                     |
| CO5                                                                                   | Elaborate the concept of automatic control system.                                            | K2                                     |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                                                                           |          |          |          |     |     |     |     |     |      |      |      |      |          |          |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|----------|-----|-----|-----|-----|-----|------|------|------|------|----------|----------|
| COs/POs                                             | PO1                                                                                                                                                                                                       | PO2      | PO3      | PO4      | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2     | PSO3     |
| CO1                                                 | 3                                                                                                                                                                                                         | 2        | 2        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3        | 2        |
| CO2                                                 | 3                                                                                                                                                                                                         | 2        | 2        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3        | 2        |
| CO3                                                 | 3                                                                                                                                                                                                         | 2        | 2        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3        | 2        |
| CO4                                                 | 3                                                                                                                                                                                                         | 2        | 2        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3        | 2        |
| CO5                                                 | 3                                                                                                                                                                                                         | 3        | 3        | 2        | -   | -   | -   | -   | -   | -    | -    | -    | -    | 3        | 3        |
| <b>22NOES11</b>                                     | <b>3</b>                                                                                                                                                                                                  | <b>3</b> | <b>3</b> | <b>2</b> | -   | -   | -   | -   | -   | -    | -    | -    | -    | <b>3</b> | <b>2</b> |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                                                                           |          |          |          |     |     |     |     |     |      |      |      |      |          |          |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4                                           |          |          |          |     |     |     |     |     |      |      |      |      |          |          |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.3.1, 2.3.2, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4                                                                       |          |          |          |     |     |     |     |     |      |      |      |      |          |          |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2                                           |          |          |          |     |     |     |     |     |      |      |      |      |          |          |
| CO4                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 3.1.5, 3.1.6, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2                                           |          |          |          |     |     |     |     |     |      |      |      |      |          |          |
| CO5                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4, 2.3.1, 2.3.2, 2.4.1, 2.4.2, 3.1.5, 3.1.6, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.1, 3.4.2, 4.1.2, 4.1.3, 4.1.4, 4.2.1, 4.2.2 |          |          |          |     |     |     |     |     |      |      |      |      |          |          |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 40                | 60                   |                |                 |                   |                 | 100     |
| CAT2                                                         | 40                | 60                   |                |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 30                | 70                   |                |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 30                | 70                   |                |                 |                   |                 | 100     |
| ESE                                                          | 40                | 60                   |                |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                  |                                                          |
|------------------|----------------------------------------------------------|
| <b>22NOE\$12</b> | <b>INDUSTRIAL AUTOMATION</b><br>(Common to All Branches) |
|------------------|----------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                 |                                                                                                                                                           |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                         | To elaborate on the basic concept of automation, including the necessary components and various automation controllers utilized in industrial automation. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                 | <b>INTRODUCTION TO AUTOMATION</b>                                                                                                                         | <b>9 Periods</b> |  |
| Automation overview – Requirement of automation systems – Architecture of industrial automation system –Industrial bus systems: Modbus and Profibus.Introduction to Industry 4.0 and its evolution.                                                                                             |                                                                                                                                                           |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                | <b>AUTOMATION COMPONENTS</b>                                                                                                                              | <b>9 Periods</b> |  |
| Sensors for temperature – Pressure – Force – Displacement - Speed – Flow- level – Humidity and pH measurement. Actuators – Process control valves –Power electronic drives: DIAC- TRIAC –power MOSFET – IGBT. Introduction to DC and AC servo drives for motion control.                        |                                                                                                                                                           |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                               | <b>PROGRAMMABLE LOGIC CONTROLLERS</b>                                                                                                                     | <b>9 Periods</b> |  |
| PLC Hardware – power supplies and isolators –Relays – Switches -Seal-in circuits – PLC programming – ladder diagram – sequential flow chart – PLC communication and networking – PLC selection – PLC installation – Advantages – Application of PLC to process control industries and Robotics. |                                                                                                                                                           |                  |  |
| <b>UNIT - IV</b>                                                                                                                                                                                                                                                                                | <b>DISTRIBUTED CONTROL SYSTEM</b>                                                                                                                         | <b>9 Periods</b> |  |
| Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers.                                                                                                                                      |                                                                                                                                                           |                  |  |
| <b>UNIT - V</b>                                                                                                                                                                                                                                                                                 | <b>SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEMS</b>                                                                                                   | <b>9 Periods</b> |  |
| Introduction - Supervisory Control and Data Acquisition Systems – SCADA HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.                                                                                                                       |                                                                                                                                                           |                  |  |
| <b>Contact Periods: 45 Periods</b>                                                                                                                                                                                                                                                              |                                                                                                                                                           |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                            |                                                                                                                                                           |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------|
| 1 | Frank D. Petruzella, " <b>Programmable Logic Controllers</b> ", 5 <sup>th</sup> Edition, McGraw Hill, 2016.         |
| 2 | S.K. Singh " <b>Industrial Instrumentation and Control</b> ", 3 <sup>rd</sup> Edition, McGraw Hill Companies, 2004. |

**REFERENCES:**

|   |                                                                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Sudip Misra, Chandana Roy, Anandarup Mukherjee, " <b>Introduction to Industrial Internet of Things and Industry 4.0</b> ", CRC Press, 1 <sup>st</sup> edition, 2021 |
| 2 | Bela G Liptak, " <b>Process software and digital networks – Volume 3</b> ", 4 <sup>th</sup> Edition, CRC press, 2012.                                               |
| 3 | Romily Bowden, " <b>HART application guide and the OSI communication foundation</b> ", 1999.                                                                        |
| 4 | John.W. Webb Ronald A Reis, " <b>Programmable Logic Controllers - Principles and Applications</b> ", Prentice Hall Inc., 5 <sup>th</sup> Edition, 2003.             |
| 5 | M. P. Lukcas, " <b>Distributed Control Systems</b> ", Van Nostrand Reinhold Co., 1986.                                                                              |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES</b>                                      |                                                                                                               | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                                               |                                |
| CO1                                                         | Elaborate the basic architecture of automation systems and Industry 4.0.                                      | K2                             |
| CO2                                                         | Describe the various automation components and industrial bus system involved in industrial automation        | K2                             |
| CO3                                                         | Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications | K3                             |
| CO4                                                         | Illustrate the functionary components and supervisory control of DCS with relevant diagrams                   | K2                             |
| CO5                                                         | Describe the basics of SCADA technology.                                                                      | K2                             |

## COURSE ARTICULATION MATRIX

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                                              |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                                                                          | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                                                                                            | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 3    |
| CO2                                                 | 3                                                                                                                                                                            | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 3    |
| CO3                                                 | 3                                                                                                                                                                            | 3   | 2   | 2   | -   | -   | -   | -   | 1   | -    | -    | 2    | 1    | 3    | 3    |
| CO4                                                 | 3                                                                                                                                                                            | 2   | 2   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 3    |
| CO5                                                 | 3                                                                                                                                                                            | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 3    | 3    |
| <b>22NOES12</b>                                     | 3                                                                                                                                                                            | 3   | 2   | 1   | -   | -   | -   | -   | 1   | -    | -    | 1    | 1    | 3    | 3    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                                              |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.3.1, 3.3.2.                                                                                   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.3.1, 3.3.2.                                                                                   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.2.1, 4.2.2, 9.1.1, 9.1.2, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO4                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.3.1, 3.3.2.                                                                                   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO5                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.3.1, 2.4.3, 3.1.1, 3.1.2, 3.1.3, 3.3.1, 3.3.2.                                                                                   |     |     |     |     |     |     |     |     |      |      |      |      |      |      |

| <b>ASSESSMENT PATTERN - THEORY</b>                           |                   |                      |                |                 |                   |                 |         |
|--------------------------------------------------------------|-------------------|----------------------|----------------|-----------------|-------------------|-----------------|---------|
| Test/Bloom's Category                                        | Remembering (K1)% | Understanding (K2) % | Applying (K3)% | Analyzing (K4)% | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| CAT2                                                         | 20                | 60                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                | 60                   | 20             |                 |                   |                 | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                | 60                   | 20             |                 |                   |                 | 100     |
| ESE                                                          | 20                | 60                   | 20             |                 |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                  |                                                        |
|------------------|--------------------------------------------------------|
| <b>22SOE\$13</b> | <b>PROGRAMMING IN JAVA</b><br>(Common to All Branches) |
|------------------|--------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                         |                                                                                                                                             |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>Course Objectives</b>                                                                                                                                                | The objective of this course is to provide students with the essential Java constructs necessary for developing an object-oriented program. |                  |  |
| <b>UNIT – I</b>                                                                                                                                                         | <b>FUNDAMENTALS OF JAVA PROGRAMMING</b>                                                                                                     | <b>9 Periods</b> |  |
| History and Evolution of Java- Overview of java– Operators- Control Structures– Methods- Classes and Objects– Inheritance- Packages and Interfaces- Exception Handling. |                                                                                                                                             |                  |  |
| <b>UNIT – II</b>                                                                                                                                                        | <b>THREADS , I/O AND STRING HANDLING</b>                                                                                                    | <b>9 Periods</b> |  |
| Multi threaded Programming– Enumeration- Auto boxing– Annotations- String Handling-Input/Output: Exploring java.io                                                      |                                                                                                                                             |                  |  |
| <b>UNIT – III</b>                                                                                                                                                       | <b>EVENT HANDLING</b>                                                                                                                       | <b>9 Periods</b> |  |
| Introducing the AWT: working with windows- graphics and text- Using AWT controls- Layout Manager - Menus - Introducing Swing                                            |                                                                                                                                             |                  |  |
| <b>UNIT – IV</b>                                                                                                                                                        | <b>IMAGING AND DATABASE CONNECTIVITY</b>                                                                                                    | <b>9 Periods</b> |  |
| Imaging: Creating- loading and displaying- Image observer- Double buffering- Media tracker- Image producer– consumer– filters– animation- Java Database Connectivity    |                                                                                                                                             |                  |  |
| <b>UNIT – V</b>                                                                                                                                                         | <b>NETWORKING</b>                                                                                                                           | <b>9 Periods</b> |  |
| Networking – Remote Method Invocation – Java Beans –Java servlets                                                                                                       |                                                                                                                                             |                  |  |
| <b>Contact Periods:</b>                                                                                                                                                 |                                                                                                                                             |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                    |                                                                                                                                             |                  |  |

**TEXT BOOKS**

|   |                                                                                                          |
|---|----------------------------------------------------------------------------------------------------------|
| 1 | Herbert Schildt, “Java, <i>The Complete Reference</i> “, Tata McGrawHill, 12 <sup>th</sup> Edition, 2022 |
|---|----------------------------------------------------------------------------------------------------------|

**REFERENCES**

|   |                                                                                                                                                                              |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Deitel .H.M and Deitel.P.J, “ <i>Java: How to Program</i> “, Pearson Education Asia, 9 <sup>th</sup> Edition 2011                                                            |
| 2 | Lay.S&Horstmann Gary Cornell, “ <i>Core Java Vol I</i> “, The Sun Microsystems & press Java Series, 9 <sup>th</sup> Edition, 2012                                            |
| 3 | NPTEL Course : “ <i>PROGRAMMING IN JAVA</i> ”<br><a href="https://archive.nptel.ac.in/courses/106/105/106105191/">https://archive.nptel.ac.in/courses/106/105/106105191/</a> |

| <b>COURSE OUTCOMES:</b><br>Upon completion of the course, the students will be able to: |                                                                                                                                                 | <b>Bloom’s Taxonomy Mapped</b> |
|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| CO1                                                                                     | Write simple java programs using fundamental concepts of java like control structures, inheritance, packages, interfaces and exception handling | K4                             |
| CO2                                                                                     | Write java program using multithreading and string handling                                                                                     | K3                             |
| CO3                                                                                     | Write java programs for managing events and to access database                                                                                  | K4                             |
| CO4                                                                                     | Write java programs to display and manipulation of graphical images                                                                             | K3                             |
| CO5                                                                                     | Develop client server programs using RMI and servlets                                                                                           | K3                             |

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**COURSE ARTICULATION MATRIX:**

| COs / POs       | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|-----------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| CO1             | 2    | 2    | 2    | 2    | 1    | -    | -    | -    | -    | 2     | -     | -     | 1     | 2     | 2     |
| CO2             | 2    | 1    | 2    | 2    | 1    | -    | -    | -    | -    | 2     | -     | -     | -     | 2     | 3     |
| CO3             | 2    | 1    | 2    | 2    | 1    | -    | -    | -    | -    | 2     | -     | -     | 1     | 2     | 3     |
| CO4             | 2    | 1    | 2    | 2    | 1    | -    | -    | -    | -    | 2     | -     | -     | 1     | 2     | 3     |
| CO5             | 2    | 1    | 2    | 2    | 1    | -    | -    | -    | -    | 2     | -     | 2     | 1     | 2     | 3     |
| <b>22SOES13</b> | 2    | 2    | 2    | 2    | 1    | -    | -    | -    | -    | 2     | -     | 1     | 1     | 2     | 3     |

**b) CO and Key Performance Indicators Mapping**

|     |                                                                                                                                                                    |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2, 10.1.1, 10.1.2, 10.1.3 |
| CO2 | 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2, 10.1.1, 10.1.2, 10.1.3 |
| CO3 | 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2, 10.1.1, 10.1.2, 10.1.3 |
| CO4 | 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.2.1, 2.2.3, 2.2.4, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.1, 3.3.2, 4.1.1, 4.1.2, 4.1.3, 4.2.1, 4.3.1, 4.3.2, 5.2.2, 10.1.1, 10.1.2, 10.1.3 |
| CO5 | 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.4.3, 3.1.5, 3.1.6, 3.2.2, 3.3.2, 4.1.1, 4.1.2, 4.2.1, 4.3.1, 4.3.2, 5.1.1, 5.2.2, 10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.2.1, 12.2.2     |

**ASSESSMENT PATTERN – THEORY**

| Test / Bloom's Category*                                           | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| CAT1                                                               |                    | 30                   | 40              | 30               |                   |                 | 100     |
| CAT2                                                               | 10                 | 30                   | 40              | 20               |                   |                 | 100     |
| Individual Assessment 1<br>/Case Study 1/ Seminar 1<br>/ Project1  |                    |                      | 70              | 30               |                   |                 | 100     |
| Individual Assessment 2<br>/Case Study 2/ Seminar 2<br>/ Project 2 |                    |                      | 50              | 50               |                   |                 | 100     |
| ESE                                                                |                    | 30                   | 40              | 30               |                   |                 | 100     |

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|                  |                                                       |
|------------------|-------------------------------------------------------|
| <b>22SOE\$14</b> | <b>NETWORK ESSENTIALS</b><br>(Common to All Branches) |
|------------------|-------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                    |                  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                                                                                   | The objective of the course is to understand the basics of networking and able to configure and troubleshoot switches and routers. |                  |  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                                                                                            | <b>INTRODUCTION</b>                                                                                                                | <b>9 Periods</b> |  |
| Introduction to Computer Networks - Goals and advantages of Computer Networks - Network Topologies – Basic networking devices – Protocols – the need for a layered architecture - The OSI Model and the TCP/IP reference model – the Ethernet LAN – Home Networking – Assembling an office LAN – Testing and Troubleshooting a LAN – Physical layer cabling: Twisted pair and Fiber optics |                                                                                                                                    |                  |  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                                                                                           | <b>WIRELESS NETWORKING</b>                                                                                                         | <b>9 Periods</b> |  |
| Importance of Wireless Networking – IEEE 802.11 Wireless LANs – Bluetooth- WIMAX – RFIDs – Securing the Wireless LANs – Configuring a Point to Multipoint Wireless LAN – Interconnecting network LANs – Switch, Bridges and Routers. Interconnecting LANs with the router, Configuring the network interface-Auto negotiation                                                              |                                                                                                                                    |                  |  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                                                                                                          | <b>ADDRESSING AND ROUTING FUNDAMENTALS</b>                                                                                         | <b>9 Periods</b> |  |
| IPv4 and IPv6 addressing – Subnet masks – CIDR blocks – configuration of a router – Console port connection - user EXEC mode – Privileged EXEC mode - Configuration of a switch – Static VLAN configuration - Spanning Tree protocol – Network Management – Power over Ethernet                                                                                                            |                                                                                                                                    |                  |  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                                                                                                           | <b>ROUTING PROTOCOLS</b>                                                                                                           | <b>9 Periods</b> |  |
| Static Vs Dynamic Routing Protocols – Distance vector Routing – Link State Routing – Hybrid Routing – Configuring RIP - Network Services – DHCP, DNS - Analyzing Internet Traffic.                                                                                                                                                                                                         |                                                                                                                                    |                  |  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                                                                                            | <b>TROUBLESHOOTING AND NETWORK SECURITY</b>                                                                                        | <b>9 Periods</b> |  |
| Analyzing Computer Networks – FTP data packets – Analyzing Campus Network data traffic – Troubleshooting the router and switch interface, Troubleshooting fiber optics – Intrusion – DOS – Security software and hardware.                                                                                                                                                                 |                                                                                                                                    |                  |  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                    |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                                                                                       |                                                                                                                                    |                  |  |

**TEXT BOOK :**

|   |                                                                                                                                                      |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Jeffrey S. Beasley Piyasat Nilkaew “ <b>Network Essentials</b> ” 3 <sup>rd</sup> Edition, Pearson, 2018                                              |
| 2 | Larry L. Peterson and Bruce S. Davie “ <b>Computer Networks, A Systems Approach</b> ” 5 <sup>th</sup> edition, Morgan Kaufmann Publishers Inc, 2014. |

**REFERENCES :**

|   |                                                                                                                                                      |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Behrouz A. Forouzan, “ <b>Data Communications and Networking with TCP/IP Protocol Suite</b> ”, Sixth Edition TMH, 2022.                              |
| 2 | James F. Kurose, Keith W. Ross, “ <b>Computer Networking, A Top-Down Approach Featuring the Internet</b> ”, Eighth Edition, Pearson Education, 2021. |
| 3 | Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “ <b>Computer Networks: An Open Source Approach</b> ”, McGraw Hill, 2012.                                  |
| 4 | Nader F. Mir, “ <b>Computer and Communication Networks</b> ”, Second Edition, Prentice Hall, 2014.                                                   |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES:</b><br>Upon completion of the course, the students will be able to: |                                                                                                         | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|-----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------|
| CO1                                                                                     | Identify topologies and types of Computer Networks and enumerate the layers of the OSI model and TCP/IP | K2                                     |
| CO2                                                                                     | Explain the significance of wireless networks and configure a Wireless LAN                              | K3                                     |
| CO3                                                                                     | Configure a switcher and a router                                                                       | K3                                     |
| CO4                                                                                     | Describe basic routing algorithms and network services                                                  | K3                                     |
| CO5                                                                                     | Troubleshoot the router and switch interface                                                            | K3                                     |

| a) CO and PO Mapping                         |                                                                                                                            |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|-------|
| COs / POs                                    | PO 1                                                                                                                       | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
| CO1                                          | 2                                                                                                                          | 3    | -    | -    | -    | 1    | -    | -    | -    | -     | -     | -     | 1     | 2     | -     |
| CO2                                          | 2                                                                                                                          | 3    | -    | -    | -    | 1    | -    | -    | -    | -     | -     | -     | 1     | 2     | -     |
| CO3                                          | 2                                                                                                                          | 3    | -    | 2    | 2    | 1    | -    | -    | -    | -     | -     | -     | 1     | 2     | -     |
| CO4                                          | 2                                                                                                                          | 3    | -    | 2    | 2    | 1    | -    | -    | -    | -     | -     | -     | 1     | 2     | -     |
| CO5                                          | 2                                                                                                                          | 3    | -    | 2    | 2    | 1    | -    | -    | -    | -     | -     | -     | 1     | 2     | -     |
| 22SOE\$14                                    | 2                                                                                                                          | 3    | -    | 2    | 2    | 1    | -    | -    | -    | -     | -     | -     | 1     | 2     | -     |
| 1 – Slight, 2 – Moderate, 3 – Substantial    |                                                                                                                            |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| b) CO and Key Performance Indicators Mapping |                                                                                                                            |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO1                                          | 1.3.1, 1.4.1, 2.1.2, 2.2.2, 2.4.4, , 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2                                 |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO2                                          | 1.3.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2               |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO3                                          | 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2 |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO4                                          | 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2 |      |      |      |      |      |      |      |      |       |       |       |       |       |       |
| CO5                                          | 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.1, 2.2.2, 2.2.3,2.2.4, 4.1.1, 4.1.2, 5.1.1, 5.1.2,5.2.1, 5.2.2, 5.3.2, 6.1.1, 6.1.2 |      |      |      |      |      |      |      |      |       |       |       |       |       |       |

| <b>ASSESSMENT PATTERN – THEORY</b>                                 |                    |                      |                 |                  |                   |                 |         |
|--------------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| Test / Bloom's Category*                                           | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                               | 30                 | 35                   | 35              |                  |                   |                 | 100     |
| CAT2                                                               | 10                 | 45                   | 45              |                  |                   |                 | 100     |
| Individual Assessment 1<br>/Case Study 1/ Seminar 1<br>/ Project1  |                    | 50                   | 50              |                  |                   |                 | 100     |
| Individual Assessment 2<br>/Case Study 2/ Seminar 2<br>/ Project 2 |                    | 50                   | 50              |                  |                   |                 | 100     |
| ESE                                                                | 10                 | 40                   | 50              |                  |                   |                 | 100     |

|                  |                                                               |
|------------------|---------------------------------------------------------------|
| <b>2210E\$15</b> | <b>VIDEO CREATION AND EDITING</b><br>(Common to All Branches) |
|------------------|---------------------------------------------------------------|

| PREREQUISITES                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                    | CATEGORY | L | T | P         | C |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|---|-----------|---|
| NIL                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                    | OE       | 3 | 0 | 0         | 3 |
| Course Objective                                                                                                                                                                                                                                 | Upon completion of the course the students will be familiar with the principles and techniques of video creation and editing, video production equipment and software, visual storytelling and video production, planning, executing, and editing video projects. also able to foster critical thinking and creativity in developing and executing video projects. |          |   |   |           |   |
| UNIT – I                                                                                                                                                                                                                                         | INTRODUCTION TO VIDEO CREATION AND EDITING                                                                                                                                                                                                                                                                                                                         |          |   |   | 9 Periods |   |
| Overview of video creation and editing -Brief history of video and film production -Understanding visual storytelling: developing documentary and dramatic projects- introduction to digital and film systems                                    |                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |           |   |
| UNIT – II                                                                                                                                                                                                                                        | PRE-PRODUCTION                                                                                                                                                                                                                                                                                                                                                     |          |   |   | 9 Periods |   |
| Developing a concept and idea - Scriptwriting and storytelling -The Digital image - Film systems and cameras - The film image - Case Study : Non linear editing system                                                                           |                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |           |   |
| UNIT – III                                                                                                                                                                                                                                       | PRODUCTION                                                                                                                                                                                                                                                                                                                                                         |          |   |   | 9 Periods |   |
| Camera operation and techniques: The video camcorder- The Lens - Lighting and sound recording techniques - Directing actors and crew -Conducting interviews -Shooting the movie - Case Study : Professional video zoom lenses                    |                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |           |   |
| UNIT – IV                                                                                                                                                                                                                                        | POST-PRODUCTION                                                                                                                                                                                                                                                                                                                                                    |          |   |   | 9 Periods |   |
| Picture and Dialogue editing - Editing digital video -sound editing and mixing -Color grading and correction- Sound editing and mixing – working with film in post production Case Study : Digital Audio Recording                               |                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |           |   |
| UNIT – V                                                                                                                                                                                                                                         | DISTRIBUTION AND PROMOTION                                                                                                                                                                                                                                                                                                                                         |          |   |   | 9 Periods |   |
| Presenting the project - funding sources - budgets- business arrangements- legal and copyright issues- distribution and marketing - publicity and the marketing campaigns-building and sustaining a career -Case Study : Creating a short movie. |                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |           |   |
| Contact Periods:                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |           |   |
| Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                    |          |   |   |           |   |

**TEXT BOOK :**

|   |                                                                                                                                                            |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Steven Ascher and Edward Pincus, <i>The Filmmaker's Handbook: A Comprehensive Guide for the Digital Age</i> , Fifth edition Penguin Publishing Group, 2012 |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------|

**REFERENCES :**

|                                                                                         |                                                                                                                  |                                        |
|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|----------------------------------------|
| 1                                                                                       | <i>Walter Murch,In the Blink of an Eye: A Perspective on Film Editing", Silman-James Press,2001</i>              |                                        |
| 2                                                                                       | <i>Karel Reisz and Gavin Millar,The Technique of Film Editing",second edition ,Taylor and Francis Group 2017</i> |                                        |
| 3                                                                                       | <i>Ken Dancyger, The technique of film and video editing , fifth edition , Elsevier 2011.</i>                    |                                        |
| 4                                                                                       | <i>Chris Kenworthy,Digital video production cookbook, OReillyMedia ,2006</i>                                     |                                        |
| 5                                                                                       | <i>Mark Brindle, The Digital Filmmaking Handbook ,Quercus Publishing, 2014</i>                                   |                                        |
| <b>COURSE OUTCOMES:</b><br>Upon completion of the course, the students will be able to: |                                                                                                                  | <b>Bloom’s<br/>Taxonomy<br/>Mapped</b> |
| CO1                                                                                     | Demonstrate an understanding of the history and evolution of video production and editing.                       | K2                                     |
| CO2                                                                                     | Develop and execute a concept, script, and storyboard for a video project                                        | K3                                     |
| CO3                                                                                     | Plan and prepare for a video shoot, including casting, location scouting, and budgeting.                         | K3                                     |
| CO4                                                                                     | Edit and assemble video footage using basic and advanced editing techniques.                                     | K2                                     |
| CO5                                                                                     | Promote and distribute the final video on various platforms.                                                     | K1                                     |

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| <b>Course Articulation Matrix</b>                   |                                                                                                                                                                                                                                                                                                                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs/ POs                                            | PO1                                                                                                                                                                                                                                                                                                                                             | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1                                                 | 2                                                                                                                                                                                                                                                                                                                                               | 1   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | 1    |
| CO2                                                 | 1                                                                                                                                                                                                                                                                                                                                               | 2   | 3   | 2   | 3   | -   | -   | -   | -   | -    | -    | -    | 1    | 1    |
| CO3                                                 | 1                                                                                                                                                                                                                                                                                                                                               | 2   | 1   | 3   | 3   | -   | 1   | -   | 3   | 1    | 2    | -    | 1    | 1    |
| CO4                                                 | 1                                                                                                                                                                                                                                                                                                                                               | 2   | 2   | 2   | 3   | 3   | -   | -   | 3   | 1    | 2    | -    | 1    | 1    |
| CO5                                                 | 1                                                                                                                                                                                                                                                                                                                                               | 2   | 2   | 2   | 3   | 3   | 1   | 3   | 3   | 3    | 2    | -    | 1    | 1    |
| <b>22IOES15</b>                                     | 1                                                                                                                                                                                                                                                                                                                                               | 2   | 2   | 2   | 2   | 1   | 1   | 1   | 2   | 1    | 1    | -    | 1    | 1    |
| 1– Slight, 2 – Moderate, 3 – Substantial            |                                                                                                                                                                                                                                                                                                                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |
| <b>b) CO and Key Performance Indicators Mapping</b> |                                                                                                                                                                                                                                                                                                                                                 |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO                                                  | Key Performance Indicators                                                                                                                                                                                                                                                                                                                      |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO1                                                 | 1.1.1,1.2.1,1.3.1,2.1.1,2.1.2,2.2.4,2.4.1,3.1.4,3.4.1,4.1.3,                                                                                                                                                                                                                                                                                    |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2                                                 | 1.1.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.4.3,3.1.1,3.1.2,3.1.3,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,3.4.1,3.4.2,4.1.1,4.1.3,4.2.1,4.3.1,4.3.2,4.3.4,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2,                                                                                                                                                                  |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3                                                 | 1.1.1,2.1.1,2.1.3,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.3,3.2.1,3.2.2,3.3.1,3.4.2,4.1.1,4.1.3,4.1.4,4.2.2,4.3.1,4.3.2,4.3.3,,5.1.1,5.1.2,5.2.1,5.2.2,5.3.2,7.1.1,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,10.1.1,11.2.1,11.3.1,11.3.2                                                                                                                    |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO4                                                 | 1.1.1,2.1.1,2.1.3,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.2,2.4.3,3.2.1,3.2.2,3.3.1,,3.3.2,3.4.2,4.1.1,4.1.3,4.2.1,,4.3.1,4.3.2,5.1.1,5.1.2,5.2.1,5.2.2,5.3.2,6.1.1,6.1.2,,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,10.1.1,11.3.1,11.3.2                                                                                                                         |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO5                                                 | 1.1.1 , 2.1.3, 2.2.1, 2.2.2, 2.2.3, 2.2.4,2.3.2, 2.4.3, 3.2.1, 3.2.3, 3.3.1, 3.3.2, 3.4.2, 4.1.1, 4.1.3, 4.3.1, 4.3.2, 4.3.3, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2, 6.1.1, 6.2.1, 7.1.2, 8.1.1, 8.2.1,8.2.2, , 9.1.1, 9.1.2, 9.2.1,9.2.2, 9.2.3,9.2.4, 9.3.1, 10.1.1, 10.1.2, 10.1.3,10.2.1, 10.2.2, 10.3.1, 10.3.2, 11.1.1, 11.1.2, 11.2.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |

| <b>ASSESSMENT PATTERN – THEORY</b>         |                    |                      |                 |                  |                   |                 |         |
|--------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| Test / Bloom's Category*                   | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                       | 30                 | 30                   | 40              |                  |                   |                 | 100     |
| CAT2                                       | 30                 | 30                   | 40              |                  |                   |                 | 100     |
| Assignment 1                               | 30                 | 30                   | 40              |                  |                   |                 | 100     |
| Assignment 2                               | 30                 | 30                   | 40              |                  |                   |                 | 100     |
| Other mode of internal assessments, if any | --                 | --                   | --              | --               | --                | --              | --      |
| ESE                                        | 30                 | 30                   | 40              |                  |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                      |
|-----------------|------------------------------------------------------|
| <b>22IOES16</b> | <b>DIGITAL MARKETING</b><br>(Common to All Branches) |
|-----------------|------------------------------------------------------|

|                      |                 |          |          |          |          |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>NIL</b>           | <b>OE</b>       | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

|                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                             | To give insight on the framework to analyze, strategies and plan digital marketing and communication activities for typical marketing situations. Familiarize with the key tools and techniques of digital marketing that are popularly used by professionals in the real world of digital marketing and help them develop the ability to formulate and analyze key metrics to evaluate the performance of typical digital marketing efforts. |                  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                     | <b>INTRODUCTION TO DIGITAL MARKETING</b>                                                                                                                                                                                                                                                                                                                                                                                                      | <b>9 Periods</b> |
| Basics of Digital Marketing - online marketplace analysis: digital marketing environment - consumer choice and digital influence online consumer behavior-competitors -suppliers- new channel structures - rate of environment change - economic force-political force -legal force - social force- cultural force. |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                    | <b>DIGITAL MARKETING STRATEGY DEVELOPMENT</b>                                                                                                                                                                                                                                                                                                                                                                                                 | <b>9 Periods</b> |
| Digital marketing strategy - The impact of digital media and technology on the marketing mix: product- price-place-promotion -people, process and physical evidence - relationship marketing using digital platforms: the challenge of customer engagement - customer lifecycle management                          |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                                   | <b>DIGITAL MARKETING IMPLEMENTATION AND PRACTICE</b>                                                                                                                                                                                                                                                                                                                                                                                          | <b>9 Periods</b> |
| Delivering the online customer experience: planning website design and redesign projects - initiation of the website project - defining site or app requirement - designing the user experience - development and testing of content - site promotion or traffic building - campaign planning for digital media     |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                                    | <b>MARKETING COMMUNICATIONS USING DIGITAL MEDIA CHANNELS</b>                                                                                                                                                                                                                                                                                                                                                                                  | <b>9 Periods</b> |
| Search engine marketing - online public relations - affiliated marketing - interactive display advertising -email marketing and mobile text messaging- social media and viral marketing - offline promotion techniques                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                     | <b>EVALUATION OF DIGITAL CHANNEL PERFORMANCE</b>                                                                                                                                                                                                                                                                                                                                                                                              | <b>9 Periods</b> |
| Create a performance management system - performance metric framework - tools and techniques for collecting metrics -customer experience and content management - online consumer behavior- online retailing - customer acquisition in B2B marketing -online inter- organizational trading                          |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |
| <b>Lecture: 45 Periods    Tutorial: 0 Periods    Practical: 0 Periods    Total: 45 Periods</b>                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                               |                  |

**TEXT BOOK :**

|   |                                                                                 |
|---|---------------------------------------------------------------------------------|
| 1 | <i>Dave Chaffey Fiona Ellis-Chadwick, Digital Marketing,sixth edition, 2016</i> |
|---|---------------------------------------------------------------------------------|

**REFERENCES :**

|    |                                                                                                                                                                                                       |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | <i>Puneet singh Bhatia, Fundamentals of Digital Marketing , Pearson India Education services,2017</i>                                                                                                 |
| 2  | <i>Mathur, Vibha, Arora, Saloni,"DigitalMarketing",PHI Learning Pvt. Ltd.,2020</i>                                                                                                                    |
| 3  | <i>Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns, Wiley 2016</i>                                                    |
| 4  | <i>Dr.Shakti Kundu, Digital Marketing Trends and Prospects:Develop an effective Digital Marketing strategy with SEO, SEM, PPC, Digital Display Ads &amp; Email Marketing techniques,BPB PUBN,2021</i> |
| 5  | <i>Seema Gupta , Digital Marketing,Third Edition, McGraw Hill 2022</i>                                                                                                                                |
| 6. | <i>Simon Kingsnorth, Digital Marketing Strategy:An Integrated Approach to Online Marketing, Kogan page,2022</i>                                                                                       |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES:</b>                                      |                                                                                                                                     | <b>Bloom's Taxonomy Mapped</b> |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                                                     |                                |
| CO1                                                          | Explain the role and importance of digital marketing in a rapidly changing business landscape                                       | K1                             |
| CO2                                                          | Discuss the key elements of a digital marketing strategy                                                                            | K2                             |
| CO3                                                          | Demonstrate advanced practical skills in common digital marketing tools such as Social media and Blogs                              | K2                             |
| CO4                                                          | Demonstrate advanced practical skills in common digital marketing tools such as SEM                                                 | K2                             |
| CO5                                                          | understand online consumer behavior and influence the extent to which individuals are likely to engage with the digital marketplace | K2                             |

| <b>Course Articulation Matrix</b>        |      |      |      |      |      |      |      |      |      |       |       |       |       |       |
|------------------------------------------|------|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| COs / POs                                | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1                                      | 1    | 1    | 2    | 2    | -    | -    | -    | -    | -    | -     | -     | -     | 2     | 2     |
| CO2                                      | 1    | 1    | 2    | 2    | -    | -    | -    | -    | -    | -     | -     | -     | 2     | 2     |
| CO3                                      | 1    | 1    | 2    | 2    | 3    | -    | -    | -    | -    | -     | -     | -     | 2     | 2     |
| CO4                                      | 1    | 1    | 2    | 2    | 3    | 2    | 3    | 3    | 3    | 3     | 3     | 3     | 2     | 2     |
| CO5                                      | 1    | 1    | 2    | 2    | 1    |      | 3    | 3    | 3    | 3     | 3     | 3     | 2     | 2     |
| <b>22IOES16</b>                          | 1    | 1    | 2    | 2    | 1    | 1    | 1    | 1    | 1    | 1     | 1     | 1     | 2     | 2     |
| 1– Slight, 2 – Moderate, 3 – Substantial |      |      |      |      |      |      |      |      |      |       |       |       |       |       |

## b) CO and Key Performance Indicators Mapping

| CO  | Key Performance Indicators                                                                                                                                                                                                                                                                                                                      |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1 | 1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,                                                                                                                                                                                                                                                                  |
| CO2 | 1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,                                                                                                                                                                                                                                                                  |
| CO3 | 1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3,5.1.1,5.1.2,5.2.1,5.2.2,5.3.1,5.3.2                                                                                                                                                                                                                               |
| CO4 | 1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3, 5.1.1,5.1.2,5.2.1, 5.2.2,5.3.1,5.3.2,6.1.1,7.1.1,7.1.2,7.2.1,7.2.2,8.1.1,8.2.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1, 10.1.1, 10.1.2,10.1.3,10.2.1,10.2.2,10.3.1,10.3.2, 11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2, 12.2.1,12.2.2,12.3.1,12.3.2 |
| CO5 | 1.1.1,2.1.1,2.1.2,3.1.1,3.1.6,3.2.1,3.2.2,3.2.3,3.3.1,4.1.1,4.1.3,4.2.1,4.3.3, 5.1.1,5.1.2,5.2.1, 7.1.1,7.1.2,7.2.1,7.2.2,8.1.1,8.2.1,8.2.2,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,9.2.4,9.3.1, 10.1.1,10.1.2,10.1.3, 10.2.1,10.2.2,10.3.1,10.3.2,11.1.1,11.1.2,11.2.1,11.3.1,11.3.2,12.1.1,12.1.2,12.2.1,12.2.2,12.3.1,12.3.2                           |

## ASSESSMENT PATTERN – THEORY (Times New Roman, Size 11)

| Test / Bloom's Category*                   | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| CAT1                                       | 30                 | 30                   | 40              |                  |                   |                 | 100     |
| CAT2                                       | 30                 | 30                   | 40              |                  |                   |                 | 100     |
| Assignment 1                               | 30                 | 30                   | 40              |                  |                   |                 | 100     |
| Assignment 2                               | 30                 | 30                   | 40              |                  |                   |                 | 100     |
| Other mode of internal assessments, if any | --                 | --                   | --              | --               | --                | --              | --      |
| ESE                                        | 30                 | 30                   | 40              |                  |                   |                 | 100     |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                 |                                                                  |
|-----------------|------------------------------------------------------------------|
| <b>22BOES17</b> | <b>PRINCIPLES OF FOOD TECHNOLOGY</b><br>(Common to All Branches) |
|-----------------|------------------------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                             |                            |                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-----------------------------|
| <b>Course Objective</b>                                                                                                                                                                                                                                                                                            | To learn about the various food constituents and its additives. To learn about various microbes associated with food. To learn about different food processing and preservation techniques. |                            |                             |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                    | <b>FOOD AND ENERGY</b>                                                                                                                                                                      | <b>9 Periods</b>           |                             |
| Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics.                                                                                                          |                                                                                                                                                                                             |                            |                             |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                   | <b>FOOD BORNE DISEASES</b>                                                                                                                                                                  | <b>9 Periods</b>           |                             |
| Classification – food infections – bacterial and other types; food intoxications and poisonings– bacterial and non-bacterial; food spoilage – factors responsible for spoilage, spoilage of vegetable, fruit, meat, poultry, beverage and other food products.                                                     |                                                                                                                                                                                             |                            |                             |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                                  | <b>FOOD ADDITIVES</b>                                                                                                                                                                       | <b>9 Periods</b>           |                             |
| Classification, intentional and non-intentional additives, functional role in food processing and preservation; food colourants – natural and artificial; food flavours; enzymes as food processing aids.                                                                                                          |                                                                                                                                                                                             |                            |                             |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                                   | <b>FOOD PRESERVATION</b>                                                                                                                                                                    | <b>9 Periods</b>           |                             |
| Principles involved in the use of sterilization, pasteurization and blanching, thermal death curves of microorganisms, canning; frozen storage-freezing characteristics of foods, microbial activity at low temperatures, factors affecting quality of foods in frozen storage; irradiation preservation of foods. |                                                                                                                                                                                             |                            |                             |
| <b>UNIT – V</b>                                                                                                                                                                                                                                                                                                    | <b>FOOD PACKAGING</b>                                                                                                                                                                       | <b>9 Periods</b>           |                             |
| Types of packaging material and containers; Interactions between packaging and foods; Packing - meat, dairy, fresh fruits and vegetables, beverages and confectionaries; Food packaging closure and sealing system; Nutrition labelling and legislative requirements.                                              |                                                                                                                                                                                             |                            |                             |
| <b>Contact Periods:</b>                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                             |                            |                             |
| <b>Lecture: 45 Periods</b>                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                             | <b>Tutorial: 0 Periods</b> | <b>Practical: 0 Periods</b> |
|                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                             | <b>Total: 45 Periods</b>   |                             |

**TEXT BOOK**

|   |                                                                                                                        |
|---|------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>T.P. Coultate , <b>Food – The Chemistry Of Its Components</b>, 6<sup>th</sup> Edn. Royal Society, London, 2015.</i> |
| 2 | <i>W.C. Frazier And D.C. Westhoff , <b>Food Microbiology</b>, 4th Ed., Mcgraw-Hill Book Co., New York 2013.</i>        |

**REFERENCES**

|   |                                                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Srinivasan Damodaran and Kirk L. Parkin., “Fennema’s Food Chemistry”, CRC Press, 5 thedition. 2017.</i>          |
| 2 | <i>Fellows P.J, “Food Processing Technology: Principles and Practices”, Woodhead Publishing 4 th edition, 2016.</i> |
| 3 | <i>B. Sivasanker , Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.</i>           |

# B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES:</b>                                      |                                                                                                       | <b>Bloom's Taxonomy Mapped</b> |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to: |                                                                                                       |                                |
| CO1                                                          | learn different constituents present in food and microorganism involved in processing of food.        | K1                             |
| CO2                                                          | learn principles and different preservations techniques of food can also be known.                    | K1                             |
| CO3                                                          | learn techniques involved in modern food processing and impact of the process on food quality.        | K2                             |
| CO4                                                          | Explain various preservation and packaging techniques for food product                                | K2                             |
| CO5                                                          | Describe the relationship between food and microorganism that basis for fermentation and preservation | K2                             |

## a) Course Articulation Matrix

| COs/POs         | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|-----------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1             | 1   | -   | -   | 1   | -   | -   | -   | -   | 2   | 3    | -    | -    | 1    | 3    |
| CO2             | 1   | -   | -   | -   | -   | -   | -   | -   | -   | 3    | -    | -    | 1    | 3    |
| CO3             | 1   | -   | -   | 2   | -   | 2   | -   | -   | -   | 3    | -    | -    | 1    | 3    |
| CO4             | 1   | -   | 1   | -   | -   | -   | -   | -   | -   | 3    | -    | -    | 1    | 3    |
| CO5             | 1   | -   | 2   | -   | -   | -   | -   | -   | -   | 3    | -    | -    | 1    | 3    |
| <b>22BOES17</b> | 1   | -   | 1   | 1   | -   | 2   | -   | -   | 2   | 3    | -    | -    | 1    | 3    |

1 – Slight, 2 – Moderate, 3 – Substantial

## b) CO and Key Performance Indicators Mapping

|     |                     |
|-----|---------------------|
| CO1 | 1.4.2, 2.1.3        |
| CO2 | 1.4.1, 3.1.3        |
| CO3 | 1.4.4, 2.1.4        |
| CO4 | 1.4.1, 2.1.3, 3.4.2 |
| CO5 | 1.4.1, 2.2.1        |

## ASSESSMENT PATTERN – THEORY

| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| CAT1                                                         | 50                 | 50                   | -               | -                | -                 | -               | 100     |
| CAT2                                                         | 60                 | 40                   | -               | -                | -                 | -               | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 50                 | 50                   | -               | -                | -                 | -               | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 50                 | 50                   | -               | -                | -                 | -               | 100     |
| ESE                                                          | 50                 | 50                   | -               | -                | -                 | -               | 100     |

22BOES18

**BIOLOGY FOR ENGINEERS***(Common to All Branches)*

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
| NIL           | OE       | 3 | 0 | 0 | 3 |

|                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|
| <b>Course Objectives</b>                                                                                                                                                                                                                                                                                                     | Understand and interpret commonly reported statistical measures published in healthcare research<br>Analyze the different type of data using appropriate statistical software<br>Demonstrate a good understanding of descriptive statistics and graphical tools<br>Explain fundamental concepts of estimation and hypothesis testing and be confident when interpreting P values and confidence intervals |                  |  |
| <b>UNIT – I</b>                                                                                                                                                                                                                                                                                                              | <b>BASICS OF CELL BIOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                             | <b>9 periods</b> |  |
| An overview of cells – origin and evolution of cells-cell theory-classification of cells – prokaryotic cells and eukaryotic cells; Structure of prokaryotic and eukaryotic cells and their organelles comparison of prokaryotic and eukaryotic cells; Transport across membranes – diffusion - active and passive diffusion. |                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>UNIT – II</b>                                                                                                                                                                                                                                                                                                             | <b>BASICS OF MICROBIOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                             | <b>9 periods</b> |  |
| Classification of microorganism-microscopic examination of microorganisms; Structural organization and multiplication of bacteria-viruses-algae and fungi; Microorganism used for the production of penicillin-alcohol and vitamin B-12.                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>UNIT – III</b>                                                                                                                                                                                                                                                                                                            | <b>HUMAN ANATOMY AND PHYSIOLOGY</b>                                                                                                                                                                                                                                                                                                                                                                       | <b>9 periods</b> |  |
| Basics of human anatomy-tissues of the human body-epithelial-connective-nervous and muscular; Nervous system-Respiratory System-Circulatory system and Digestive system.                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>UNIT – IV</b>                                                                                                                                                                                                                                                                                                             | <b>BIO MOLECULES AND IMMUNE SYSTEM</b>                                                                                                                                                                                                                                                                                                                                                                    | <b>9 periods</b> |  |
| Introduction to Biochemistry-classification-structure and properties of carbohydrates- proteins- lipids and nucleic acids; Innate and acquired immunity; Types of immune responses.                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>UNIT-V</b>                                                                                                                                                                                                                                                                                                                | <b>APPLIED BIOLOGY FOR ENGINEERS</b>                                                                                                                                                                                                                                                                                                                                                                      | <b>9 periods</b> |  |
| Overview of biosensors - glucometer applications-medicine; Microarray analysis to diagnose the cancer; Microbial production of biofuels; Applications of stem cells.                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>Contact Periods: 45</b>                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |
| <b>Lecture: 45 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 45 Periods</b>                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                           |                  |  |

**TEXT BOOK**

|   |                                                                                                                                     |
|---|-------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Darnell J, Lodish H, Baltimore D. “Molecular Cell Biology”, W.H.Freeman; 8th Edition, 2016.</i>                                  |
| 2 | <i>Pelczar MJ, Chan ECS and Krein NR, “Microbiology”, Tata McGraw Hill, 5th Edition, New Delhi.2001.</i>                            |
| 3 | <i>Wulf Cruger and Anneliese Cruger, “A Textbook of Industrial Microbiology”, Panima Publishing Corporation, 2nd Edition, 2000.</i> |

**REFERENCES**

|   |                                                                                                                                   |
|---|-----------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>David L. Nelson and Michael M Cox, “Lehninger’s Principles of Biochemistry”, Macmillan Worth Publisher, 4th edition, 2004.</i> |
| 2 | <i>Brain R.Eggins , “Chemical Sensors and Biosensors”, John Wiley &amp; Sons, 2002.</i>                                           |
| 3 | <i>Anton Moser, “Bioprocess Technology, Kinetics and Reactors”, Springer, Berlin (Verlag), 1st edition, 1998</i>                  |
| 4 | <i>Kuby J, “Immunology”, WH Freeman &amp; Co., 7th edition, 2013.</i>                                                             |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

| <b>COURSE OUTCOMES:</b>                                      |                                                                    | <b>Bloom's Taxonomy Mapped</b> |
|--------------------------------------------------------------|--------------------------------------------------------------------|--------------------------------|
| Upon completion of the course, the students will be able to: |                                                                    |                                |
| CO1                                                          | Understand the functions of cell and their structural organization | K1                             |
| CO2                                                          | Describe the mechanisms and role of cell in immune system          | K1                             |
| CO3                                                          | Get familiarized biomolecules and human anatomy system             | K2                             |
| CO4                                                          | Illustrate the applications of microbes in industrial process      | K3                             |
| CO5                                                          | Apply the engineering concepts in biology                          | K3                             |

| <b>a) Course Articulation Matrix</b>                |                                                                                   |     |     |     |     |     |     |     |     |       |       |       |      |      |
|-----------------------------------------------------|-----------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-------|-------|-------|------|------|
| COs/POs                                             | PO1                                                                               | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO2 |
| CO1                                                 | -                                                                                 | 1   | -   | -   | -   | 2   | 2   | 2   | -   | -     | 1     | 2     | 2    | 2    |
| CO2                                                 | 1                                                                                 | -   | -   | 1   | 1   | -   | -   | 2   | 3   | 3     | 2     | 2     | 1    | 3    |
| CO3                                                 | 1                                                                                 | 1   | -   | -   | -   | -   | -   | 1   | 1   | -     | -     | -     | 1    | 3    |
| CO4                                                 | -                                                                                 | -   | -   | -   | 1   | -   | -   | 2   | 3   | 3     | 1     | 1     | 1    | 3    |
| CO5                                                 | -                                                                                 | 2   | -   | 1   | 3   | -   | -   | -   | -   | -     | -     | -     | 2    | 2    |
| <b>22BOES18</b>                                     | 1                                                                                 | 1   | -   | 1   | 2   | 2   | 2   | 2   | 3   | 3     | 2     | 2     | 2    | 3    |
| 1 – Slight, 2 – Moderate, 3 – Substantial           |                                                                                   |     |     |     |     |     |     |     |     |       |       |       |      |      |
| <b>b) CO and Key Performance Indicators Mapping</b> |                                                                                   |     |     |     |     |     |     |     |     |       |       |       |      |      |
| CO1                                                 | 2.2.2,6.1.1,7.1.2,8.1.1,11.1.1,12.1.2                                             |     |     |     |     |     |     |     |     |       |       |       |      |      |
| CO2                                                 | 1.1.1,4.2.1,5.2.1,8.1.1,9.1.1,9.2.1,10.1.1,10.1.2,11.1.1,12.1.2                   |     |     |     |     |     |     |     |     |       |       |       |      |      |
| CO3                                                 | 1.1.1,2.1.1,8.1.1,9.1.1                                                           |     |     |     |     |     |     |     |     |       |       |       |      |      |
| CO4                                                 | 5.2.1,8.1.1,9.1.1,9.2.1,10.1.1,10.1.2,11.1.1,12.1.2                               |     |     |     |     |     |     |     |     |       |       |       |      |      |
| CO5                                                 | 1.1.1,2.2.2,4.2.1,5.2.1,6.1.1,7.1.2,8.1.1,9.1.1,9.2.1,10.1.1,10.1.2,11.1.1,12.1.2 |     |     |     |     |     |     |     |     |       |       |       |      |      |

| <b>ASSESSMENT PATTERN – THEORY</b>                           |                    |                      |                 |                  |                   |                 |         |
|--------------------------------------------------------------|--------------------|----------------------|-----------------|------------------|-------------------|-----------------|---------|
| Test / Bloom's Category*                                     | Remembering (K1) % | Understanding (K2) % | Applying (K3) % | Analyzing (K4) % | Evaluating (K5) % | Creating (K6) % | Total % |
| CAT1                                                         | 50                 | 10                   | 10              | 10               | 10                | 10              | 100     |
| CAT2                                                         | 50                 | 10                   | 10              | 10               | 10                | 10              | 100     |
| Individual Assessment 1 /Case Study 1/ Seminar 1 / Project1  | 20                 | 20                   | 20              | 20               | 10                | 10              | 100     |
| Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2 | 20                 | 20                   | 20              | 20               | 10                | 10              | 100     |
| ESE                                                          | 50                 | 10                   | 10              | 10               | 10                | 10              | 100     |

|                  |                                      |
|------------------|--------------------------------------|
| <b>22NVA\$02</b> | <b>CIRCUIT DESIGN AND SIMULATION</b> |
|------------------|--------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>EEC</b>      | <b>1</b> | <b>0</b> | <b>0</b> | <b>1</b> |

|                                                                                                                                                                                                                    |                                                                                             |                  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                            | To impart knowledge on electronic circuits design and implementation using PSpice software. |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                    | <b>CIRCUIT ANALYSIS USING PSPICE</b>                                                        | <b>5 Periods</b> |  |
| Introduction to PSPICE - Laying out a Schematic, Libraries. Kirchhoff's Laws- Potential Divider- Capacitors and Inductors. DC and AC Circuits: Mesh analysis and Nodal analysis and Maximum power transfer theorem |                                                                                             |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                   | <b>SEMICONDUCTOR DEVICES AND OPAMP CHARACTERISTICS USING PSPICE</b>                         | <b>5 Periods</b> |  |
| Semiconductor Devices: Diode, Zener Diode, Silicon-Controlled Rectifier, BJT and JFET. Operational Amplifier: Ideal Operational Amplifiers, Inverting and Noninverting Amplifier. Nand Gate and Nor gate.          |                                                                                             |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                  | <b>SERIES AND PARALLEL-TUNED CIRCUITS USING PSPICE</b>                                      | <b>5 Periods</b> |  |
| Series-Tuned Circuit,Q-Factor, Voltages Across L and C at Resonance, Selectivity of a Series-Tuned Resonant Circuit, Parallel-Tuned LCR Circuit and Frequency Response of a Parallel-Tuned Circuit.                |                                                                                             |                  |  |
| <b>Contact Periods: 15 Periods</b>                                                                                                                                                                                 |                                                                                             |                  |  |
| <b>Lecture: 15 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 15 Periods</b>                                                                                                               |                                                                                             |                  |  |

**TEXT BOOKS:**

|   |                                                                                                                                                 |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>P Tobin , "PSpice for Circuit Theory and Electronic Devices" , A Publication in the Morgan &amp; Claypool Publishers series, 2007.</i>       |
| 2 | <i>Muhammad H. Rashid, "SPICE for Power Electronics And Electric Power" CRC Pres Taylor &amp; Francis Group, 3<sup>rd</sup> edition , 2012.</i> |

**REFERENCES:**

|   |                                                                                                                                        |
|---|----------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Dennis Fitzpatrick , "Analog Design and Simulation using OrCAD Capture and PSpice" , Mara Conner, 2<sup>nd</sup> Edition, 2017.</i> |
| 2 | <i>Hayt and Kimmerly, , "Electrical Circuit Analysis, by Mc Graw Hill" 5<sup>th</sup> edition, 2017.</i>                               |
| 3 | <i>Rashid, "Introduction to PSpice Using OrCAD for Circuits and Electronics" , 3<sup>rd</sup> edition, pearson, 2015</i>               |
| 4 | <i>E.Ramshow, D.C. Schurman, "PSpice Simulation of Power Electronics Circuits: An Introductory Guide" , Springer US, 1996.</i>         |

| <b>COURSE OUTCOMES</b>                                      |                                                                                             | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|---------------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                             |                                |
| CO1                                                         | Explain the basic concept of PSpice software                                                | K2                             |
| CO2                                                         | Analyze the characteristics of semiconductor devices and operational amplifier using Pspice | K3                             |
| CO3                                                         | Implement series and parallel tuned circuits using PSpice.                                  | K3                             |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                                                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                                                                                                                 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 3                                                                                                                                                   | 2   | 1   | 3   | 2   | -   | -   | -   | -   | -    | -    | 1    | 3    | -    | 1    |
| CO2                                                 | 3                                                                                                                                                   | 2   | 1   | 3   | 2   | -   | -   | -   | -   | -    | -    | 1    | 3    | -    | 1    |
| CO3                                                 | 3                                                                                                                                                   | 2   | 1   | 3   | 2   | -   | -   | -   | -   | -    | -    | 1    | 3    | -    | 1    |
| <b>22NVA\$02</b>                                    | 2                                                                                                                                                   | 2   | 1   | 2   | 2   | -   | -   | -   | -   | -    | -    | 1    | 3    | -    | 1    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                                                                                                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.1.1, 2.1.2, 2.4.1, 2.4.2, 3.1.1, 4.1.1, 4.1.2, 4.1.2, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 12.2.1. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.1.1, 2.1.2, 2.4.1, 2.4.2, 3.1.1, 4.1.1, 4.1.2, 4.1.2, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 12.2.1. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 1.1.2, 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.1.1, 2.1.2, 2.4.1, 2.4.2, 3.1.1, 4.1.1, 4.1.2, 4.1.2, 5.1.1, 5.1.2, 5.2.1, 5.2.2, 12.2.1. |     |     |     |     |     |     |     |     |      |      |      |      |      |      |



|                  |                                   |
|------------------|-----------------------------------|
| <b>22NVA\$03</b> | <b>PCB DESIGN AND FABRICATION</b> |
|------------------|-----------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>EEC</b>      | <b>1</b> | <b>0</b> | <b>0</b> | <b>1</b> |

|                                                                                                                                                                                                                                                       |                                                                             |                  |  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                               | To impart knowledge on steps involved in PCB design and fabrication process |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                       | <b>BASICS OF PRINTED CIRCUIT BOARDS</b>                                     | <b>5 Periods</b> |  |
| PCB : Evolution, Components, Classification, Manufacturing - Challenges in modern PCB design and manufacture - PCBs with embedded components - Standards on PCBs                                                                                      |                                                                             |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                      | <b>LAYOUT PLANNING AND DESIGN</b>                                           | <b>5 Periods</b> |  |
| Reading drawings and diagrams - Mechanical design considerations - Electrical design considerations - , Component placement rules - Fabrication and assembly consideration - Cooling requirements - Packaging density - Layout design - Documentation |                                                                             |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                     | <b>SOLDERING AND ASSEMBLY</b>                                               | <b>5 Periods</b> |  |
| Soldering : Theory, Variables, Material, Tools - PCB assembly process - Solder paste and adhesive - Mass soldering - Quality control of solder joints - Re-work and repair of PCBs                                                                    |                                                                             |                  |  |
| <b>Contact Periods: 15 Periods</b>                                                                                                                                                                                                                    |                                                                             |                  |  |
| <b>Lecture: 15 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 15 Periods</b>                                                                                                                                                  |                                                                             |                  |  |

**TEXT BOOKS:**

|          |                                                                                                                                             |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | <b><i>R.S.Khandpur, “Printed Circuit Boards: Design, Fabrication, Assembly and Testing”, McGraw-Hill, 1<sup>st</sup> Edition, 2005.</i></b> |
| <b>2</b> | <b><i>Jan Axelson, “Making Printed Circuit Boards”, McGraw-Hill, 1<sup>st</sup> Edition, 1993.</i></b>                                      |

**REFERENCES:**

|          |                                                                                                                                                      |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1</b> | <b><i>Elaine Rhodes, “Developing Printed Circuit Assemblies: From Specifications to Mass Production”, Lulu.com, 1<sup>st</sup> Edition, 2008</i></b> |
| <b>2</b> | <b><i>C. Robertson. “PCB Designer's Reference”, Prentice Hall, 6<sup>th</sup> Edition, 2007</i></b>                                                  |
| <b>3</b> | <b><i>D. Brooks, “Signal Integrity Issues and Printed Circuit Board Design”, Prentice Hall, 1<sup>st</sup> Edition, 2003</i></b>                     |
| <b>4</b> | <b><i>Jon Varteresian, “Fabricating Printed Circuit Boards”, Newnes, 1<sup>st</sup> Edition, 2002</i></b>                                            |

| <b>COURSE OUTCOMES</b>                                      |                                                                | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|----------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                |                                |
| CO1                                                         | Describe the basic concepts of Printed Circuit Boards.         | K2                             |
| CO2                                                         | Develop the layout planning and design PCB for an application. | K3                             |
| CO3                                                         | Demonstrate the process of Soldering and assembly.             | K2                             |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|---------------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                           | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    | -    |
| CO2                                                 | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    | -    |
| CO3                                                 | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    | -    |
| <b>22NVA\$03</b>                                    | 2                                                             | 1   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 2    | -    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                               |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.2.1, 1.3.1, 1.4.1, 2.1.1, 2.1.2, 2.1.3, 2.2.2, 3.1.1, 3.1.6 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |



|                  |                              |
|------------------|------------------------------|
| <b>22NVA\$04</b> | <b>GRAPHIC COMMUNICATION</b> |
|------------------|------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>EEC</b>      | <b>1</b> | <b>0</b> | <b>0</b> | <b>1</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                     |                            |                             |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----------------------------|-----------------------------|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                                                                                                                                                              | To provide the foundation of problem solving software in the instrumentation field. |                            |                             |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                                                                                                                                                                      | <b>FEATURES OF MATLAB</b>                                                           | <b>5 Periods</b>           |                             |
| Command window, figure window; editor window and help window- MATLAB as a calculator - useful commands for managing variables- built-in functions for handling arrays, mathematical operations with matrices, strings as variables -Creating a script file- applications in problem solving                                                                                                                          |                                                                                     |                            |                             |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                                                                                                                                                                     | <b>SOFTWARE TOOLS FOR SENSOR DESIGN</b>                                             | <b>5 Periods</b>           |                             |
| Introduction to history of sensor design software tools, importance and need of software tools. Recent developments in sensor design and analysis software tools. Introduction to COMSOL Multiphysics, Structural Mechanics: Analysis of mechanical structures to static or dynamic loads. Stationary, transient, parametric, quasi-static and frequency response analysis.                                          |                                                                                     |                            |                             |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                                                                                                                                                                    | <b>SOLID WORKS</b>                                                                  | <b>5 Periods</b>           |                             |
| Characteristics of basic issues related to geometrical and structural modelling. Introduction to SolidWorks. Creating, editing and operations on 2D profiles - Defining geometrical and dimensional constraints in sketches - Solid modelling. Tools, methods and functions used to create solid models. - Diagnosis of problems, analysis and repair of parts-2D design documentation - Modelling using assemblies. |                                                                                     |                            |                             |
| <b>Contact Periods: 15 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                     |                            |                             |
| <b>Lecture: 15 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                     | <b>Tutorial: 0 Periods</b> | <b>Practical: 0 Periods</b> |
| <b>Total: 15 Periods</b>                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                     |                            |                             |

**TEXT BOOKS:**

|   |                                                                                                                             |
|---|-----------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Gilat Amos, "MATLAB: An Introduction with Applications", John Wiley &amp; Sons, Inc (Wiley Student Edition), 2008</i>    |
| 2 | <i>Willis J., Dogra S, "SolidWorks 2019: A Power Guide for Beginners and Intermediate User Paperback", CADArtifex, 2019</i> |

**REFERENCES:**

|   |                                                                                                                                                        |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Roger W. Pryor, "Multiphysics Modeling Using COMSOL®: A First Principles Approach", Jonesand Bartlett Publishers, 1<sup>st</sup> Edition, 2011.</i> |
| 2 | <i>Brian Hahn and Daniel Valentine, "Essential MATLAB for Engineers and Scientists", Elsevier, 6<sup>th</sup> edition, 2016.</i>                       |
| 3 | <i>Holly Moore, "MATLAB for Engineers", Pearson Education, 5<sup>th</sup> Edition, 2017.</i>                                                           |

| <b>COURSE OUTCOMES</b>                                      |                                                                                     | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                                                     |                                |
| CO1                                                         | Provide a foundation in arrays,strings of this software for real time applications. | K2                             |
| CO2                                                         | Select appropriate software tools for sensor design.                                | K2                             |
| CO3                                                         | obtain knowledge of the construction of sensors and mechanisms using SolidWorks.    | K2                             |

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|-------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 2                                   | 1   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| CO2                                                 | 2                                   | 1   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| CO3                                                 | 2                                   | 1   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| <b>22NVA\$04</b>                                    | 2                                   | 1   | -   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | -    | 2    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                     |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1,1.1.2,1.2.1,2.1.1,2.1.3,5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1,1.1.2,1.2.1,2.1.1,2.1.3,5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1,1.1.2,1.2.1,2.1.1,2.1.3,5.1.1 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |



B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

|                  |                                           |
|------------------|-------------------------------------------|
| <b>22NVA\$05</b> | <b>INTEGRATED DEVELOPMENT ENVIRONMENT</b> |
|------------------|-------------------------------------------|

| <b>PREREQUISITES</b> | <b>CATEGORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|----------------------|-----------------|----------|----------|----------|----------|
| <b>NIL</b>           | <b>EEC</b>      | <b>1</b> | <b>0</b> | <b>0</b> | <b>1</b> |

|                                                                                                                                                                                                                                                                            |                                                                                                       |                  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|------------------|--|
| <b>COURSE OBJECTIVE</b>                                                                                                                                                                                                                                                    | To provide the essential sk ills for app development using Integrated Development Environments (IDEs) |                  |  |
| <b>UNIT - I</b>                                                                                                                                                                                                                                                            | <b>INTRODUCTION</b>                                                                                   | <b>5 Periods</b> |  |
| IDEs – Brief history – Introduction to programming languages – general purpose IDEs – Language specific IDEs – Common Programming languages – C, Python and Java                                                                                                           |                                                                                                       |                  |  |
| <b>UNIT - II</b>                                                                                                                                                                                                                                                           | <b>VISUAL STUDIO CODE BASICS</b>                                                                      | <b>5 Periods</b> |  |
| Introduction – Installation - basic interface - create new files - understanding workspaces - Editor groups - Extension and Customization: Introduction - customizing themes - popular extensions. Shortcut and settings.                                                  |                                                                                                       |                  |  |
| <b>UNIT - III</b>                                                                                                                                                                                                                                                          | <b>ADVANCED CONCEPTS IN VISUAL STUDIO CODE</b>                                                        | <b>5 Periods</b> |  |
| Learn VS code for Web development - project based learning - creating the structure using HTML - Styling. VS code terminal - integrating terminal - workflow with terminal. Set up basic code environment: C/C++, Python, Java. Debugging- Use of AI in Visual studio Code |                                                                                                       |                  |  |
| <b>Contact Periods: 15 Periods</b>                                                                                                                                                                                                                                         |                                                                                                       |                  |  |
| <b>Lecture: 15 Periods      Tutorial: 0 Periods      Practical: 0 Periods      Total: 15 Periods</b>                                                                                                                                                                       |                                                                                                       |                  |  |

**TEXT BOOKS:**

|   |                                                                                                           |
|---|-----------------------------------------------------------------------------------------------------------|
| 1 | <i>Sufyan Bin Uzayr, “Mastering Visual Studio Code: A Beginner's Guide”, CRC press, 1st Edition, 2022</i> |
| 2 | <i>Alessandro Del Sole, “Visual Studio Code Distilled”, Apress, 3rd Edition, 2023</i>                     |
| 3 | <i>Coursera course on “Working with Integrated development Environments”</i>                              |

**REFERENCES:**

|   |                                                                                                                                   |
|---|-----------------------------------------------------------------------------------------------------------------------------------|
| 1 | <i>Bruce Johnson, “Visual Studio Code”, Wiley, 1st Edition, 2019.</i>                                                             |
| 2 | <i>April Speight, “Visual Studio Code for Python programmers”, Wiley, 1st Edition, 2021.</i>                                      |
| 3 | <i>Swapnil saurav, “Python Apps on Visual Studio Code”, BPB Publications, 1st Edition, 2024.</i>                                  |
| 4 | <i>Ovasis Mehboob, Ahmed Khan, “Developing Multi-Platform Apps with Visual Studio Code”, Packt Publishing, 1st Edition, 2020.</i> |

| <b>COURSE OUTCOMES</b>                                      |                                                             | <b>Bloom's Taxonomy Mapped</b> |
|-------------------------------------------------------------|-------------------------------------------------------------|--------------------------------|
| Upon Completion of the course, the students will be able to |                                                             |                                |
| CO1                                                         | Elaborate the overview of IDE and its programming languages | K2                             |
| CO2                                                         | Develop VS code for an application                          | K3                             |
| CO3                                                         | Develop and deploy an app for an application                | K3                             |

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

**COURSE ARTICULATION MATRIX**

| <b>a) CO/PO Mapping</b>                             |                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
|-----------------------------------------------------|--------------------------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|------|
| COs/POs                                             | PO1                                                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1                                                 | 1                                                      | 1   | 1   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| CO2                                                 | 1                                                      | 1   | 1   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| CO3                                                 | 1                                                      | 1   | 1   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| 22NVA\$05                                           | 1                                                      | 1   | 1   | -   | 2   | -   | -   | -   | -   | -    | -    | -    | -    | -    | -    |
| <b>b) CO and Key Performance Indicators mapping</b> |                                                        |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO1                                                 | 1.1.1, 2.1.1, 3.1.1, 3.1.2, 3.2.1, 5.1.1, 5.1.2, 5.2.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO2                                                 | 1.1.1, 2.1.1, 3.1.1, 3.1.2, 3.2.1, 5.1.1, 5.1.2, 5.2.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |
| CO3                                                 | 1.1.1, 2.1.1, 3.1.1, 3.1.2, 3.2.1, 5.1.1, 5.1.2, 5.2.2 |     |     |     |     |     |     |     |     |      |      |      |      |      |      |



|           |                           |
|-----------|---------------------------|
| 22NVA\$07 | <b>Placement Training</b> |
|-----------|---------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
|               | EEC      | 0 | 0 | 2 | 1 |

|                          |                                                                                                                                                                                                                                                                                                                |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives</b> | <ul style="list-style-type: none"> <li>To refine communication skills targeted at placement interviews (technical and HR).</li> <li>To enhance confidence in problem-solving, aptitude, and group tasks.</li> <li>To instill professional behaviour and soft skills required for workplace success.</li> </ul> |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| S. No | Topics / Activities                                                                                      | Hours |
|-------|----------------------------------------------------------------------------------------------------------|-------|
| 1     | <b>Aptitude &amp; Reasoning Training</b> – Logical puzzles, quantitative reasoning                       | 4     |
| 2     | <b>Group Discussion</b> – Real-world engineering case studies, brainstorming                             | 4     |
| 3     | <b>Leadership &amp; Teamwork Workshop</b> – Role plays, team tasks, problem solving, decision making     | 4     |
| 4     | <b>Behavioural Interviews</b> – Common HR questions, STAR method, mock HR interview                      | 4     |
| 5     | <b>Technical Interviews</b> – Mock technical questions, peer feedback, clarity of answer.                | 4     |
| 6     | <b>Personal Branding</b> – Crafting LinkedIn profile, writing cover letters, personal elevator pitch     | 4     |
| 7     | <b>Group Exercise / Presentation</b> – Group presentation on a hypothetical project                      | 4     |
| 8     | <b>Feedback &amp; Reflection Session</b> – Students reflect on their performance, set professional goals | 2     |

**Contact Periods:**

**Lecture: 00 Periods      Tutorial: 00 Periods      Practical: 30 Periods      Total: 30 Periods**

| <b>COURSE OUTCOMES:</b>                                    |                                                                        | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------|
| On completion of the course, the students will be able to: |                                                                        |                                        |
| CO1                                                        | Solve common aptitude and reasoning problems for placement tests.      | K3                                     |
| CO2                                                        | Perform well in group discussions and case-study discussions.          | K3                                     |
| CO3                                                        | Demonstrate leadership and teamwork in simulated workplace situations. | K3                                     |
| CO4                                                        | Participate confidently in technical and HR interviews.                | K3                                     |
| CO5                                                        | Develop a professional portfolio (resume, LinkedIn, cover letter).     | K6                                     |

| <b>ASSESSMENT PATTERN:</b>                      |                            |            |
|-------------------------------------------------|----------------------------|------------|
| <b>No End Semester Examination</b>              |                            |            |
| <b>Only Continuous Assessment</b>               |                            |            |
| <b>Continuous Assessment Marks distribution</b> |                            |            |
| 1.                                              | Aptitude Test              | 20         |
| 2.                                              | Group Case Presentation    | 20         |
| 3.                                              | Mock Interviews            | 25         |
| 4.                                              | Portfolio Evaluation       | 25         |
| 5.                                              | Participation & Reflection | 10         |
| <b>Total</b>                                    |                            | <b>100</b> |

|           |                                                 |
|-----------|-------------------------------------------------|
| 22NVA\$08 | <b>Professional Skills and Career Readiness</b> |
|-----------|-------------------------------------------------|

| PREREQUISITES | CATEGORY | L | T | P | C |
|---------------|----------|---|---|---|---|
|               | EEC      | 0 | 0 | 2 | 1 |

|                          |                                                                                                                                                                                                                                                                                                     |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives</b> | <ul style="list-style-type: none"> <li>To develop students' technical communication and presentation skills.</li> <li>To build confidence in public speaking, group discussions, and interviews.</li> <li>To improve English communication (verbal and written) for placement scenarios.</li> </ul> |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| S.No | Topics / Activities                                                                                            | Hours |
|------|----------------------------------------------------------------------------------------------------------------|-------|
| 1    | <b>Ice-breaker &amp; Self-introductions</b> - Students introduce themselves, Elevator pitch                    | 2     |
| 2    | <b>Technical Presentations</b> - Students prepare a short (3-4 min) presentation on a simple technical topic   | 4     |
| 3    | <b>PowerPoint/ Slide Design</b> - Best practices, visual aids, readability                                     | 3     |
| 4    | <b>Email Etiquette &amp; Writing</b> - Structure, tone, salutations, follow-up emails                          | 2     |
| 5    | <b>Report Writing</b> - Format, structure, executive summary, technical vs business report                     | 4     |
| 6    | <b>Group Discussion &amp; Debates</b> - Practice GD on technical/non-technical issues, role-playing, feedback  | 4     |
| 7    | <b>Mock Interviews</b> - One-on-one and panel interviews, feedback                                             | 4     |
| 8    | <b>Resume / CV Building</b> - Format, content, tailoring to job descriptions, highlighting projects            | 3     |
| 9    | <b>Non-verbal Communication Skills</b> - Body language, posture, eye contact, voice modulation                 | 2     |
| 10   | <b>Reflection &amp; Feedback</b> - Peer feedback, self-reflection, goal-setting for communication improvement. | 2     |

**Contact Periods:**

**Lecture: 00 Periods      Tutorial: 00 Periods      Practical: 30 Periods      Total: 30 Periods**

| <b>COURSE OUTCOMES:</b>                                    |                                                                        | <b>Bloom's<br/>Taxonomy<br/>Mapped</b> |
|------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------|
| On completion of the course, the students will be able to: |                                                                        |                                        |
| CO1                                                        | Prepare and deliver technical presentations.                           | K3                                     |
| CO2                                                        | Write professional emails, reports, and resumes.                       | K3                                     |
| CO3                                                        | Participate in group discussions and role-plays.                       | K3                                     |
| CO4                                                        | Demonstrate interview skills in mock scenarios.                        | K3                                     |
| CO5                                                        | Use non-verbal communication effectively (body language, eye contact). | K3                                     |

| <b>ASSESSMENT PATTERN:</b>                      |                                                               |            |
|-------------------------------------------------|---------------------------------------------------------------|------------|
| <b>No End Semester Examination</b>              |                                                               |            |
| <b>Only Continuous Assessment</b>               |                                                               |            |
| <b>Continuous Assessment Marks distribution</b> |                                                               |            |
| 1.                                              | Presentation Assessment                                       | 25         |
| 2.                                              | Written Assessment<br>(Emails/report/resume)                  | 20         |
| 3.                                              | Mock Interview                                                | 25         |
| 4.                                              | Participation (GDs, role-plays, and non-verbal communication) | 30         |
| <b>Total</b>                                    |                                                               | <b>100</b> |