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.
PHONE : 0422 - 2433355
e-mail: gctcoe@gct.ac.in

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.

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

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

VISION AND MISSION OF THE DEPARTMENT

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.

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

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

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.

GOVERNMENT COLLEGE OF TECHNOLOGY
(An Autonomous Institution Affiliated to Anna University)
Coimbatore–641013.
DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

PROGRAMME OUTCOMES (POs)

- **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.

•

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

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

PROGRAMME SPECIFIC OUTCOMES (PSOs)

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 – 641 013.

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING (FULL TIME)

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	தமிழர் மரபு 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	60	40	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				**480**	**520**	**1000**	**15**	**2**	**11**	**19.5**

SECOND SEMESTER

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 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
		NCC Credit Course (optional)					2	0	0	0
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	ES	60	40	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				**420**	**480**	**900**	**19**	**1**	**9**	**21.5**

FOURTH SEMESTER

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**

GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013

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*(Common to EIE, CSE and IT)*	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**

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

SEVENTH SEMESTER

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/ Professional Elective – VIII	PE/OE	40	60	100	3	0	0	3
THEORY WITH PRACTICAL										
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
TOTAL				**310**	**390**	**700**	**17**	**0**	**8**	**21**

EIGHTH SEMESTER

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	22NEE802	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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

SUMMARY OF CREDIT DISTRIBUTION

S.No	Course Category	Credits per Semester								Internship	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	-	-	-	-	-	-	2	8	4	14	8.28	15
8	MC	0	0	0	-	-	-	-	-		0	0	0
TOTAL		**19.5**	**21.5**	**21.5**	**22**	**23**	**22.5**	**22**	**14**	**4**	**169**	**100**	**160**

Total credits = 169

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

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	Technical English	HS	40	60	100	2	1	0	3
2	22NHS1Z2	Values and Ethics	HSMC	40	60	100	3	0	0	3
3	22NHS2Z3	Professional English	HSMC	40	60	100	2	1	0	3
4	22NHS606	Industrial Management and Economics	HSMC	40	60	100	3	0	0	3
TOTAL				**160**	**240**	**400**	**10**	**2**	**0**	**12**

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
TOTAL				**320**	**480**	**800**	**18**	**3**	**6**	**24**

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
TOTAL				**520**	**480**	**1000**	**17**	**0**	**16**	**25**

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
TOTAL				**1080**	**1620**	**2700**	**56**	**2**	**27**	**70**

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

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 *(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 * *(Common to EEE, ECE & EIE)*
4	22NPE$04 System Identification	22NPE$12 Aircraft Instrumentation	22NPE$20 Medical Imaging	22NPE$28 Industrial Internet of Things *(Common to ECE & EIE)*	22NPE$36 Process Control	22NPE$42 Electronic System Design and Productization * *(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 *(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 *(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 *(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 *(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 * *(Common to EEE, ECE & EIE)*	PE	40	60	100	3	0	0	3
4	22NPE$42	Electronic System Design and Productization * *(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.	22I0E$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.ELECTRONICS AND INSTRUMENTATION ENGINEERING

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	22NEE802	Capstone Project	EEC	60	40	100	0	0	16	8
3	22NEE$IX	Internship	EEC	100	0	100	0	0	0	4
TOTAL				**220**	**80**	**300**	**0**	**0**	**20**	**14**

MANDATORY COURSE (MC) – (NO CREDIT)

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
TOTAL				**80**	**120**	**200**	**6**	**0**	**0**	**0**

VALUE ADDED COURSE

Sl. No	Course Code	Course Title	Category	CA Marks	End Sem Marks	Total Marks	Hours/Week			
							L	T	P	C
1	22NVA$01	NPTEL/SWAYAM Courses	EEC	100	0	100	1	0	0	1
2	22NVA$02	Coursera Courses	EEC	100	0	100	1	0	0	1
3	22NVA$03	Edx Courses	EEC	100	0	100	1	0	0	1
3	22NVA$04	Research Publication	EEC	100	0	100	1	0	0	1
4	22NVA$05	Circuit Design and Simulation	EEC	100	0	100	1	0	0	1
5	22NVA$06	PCB Design and Fabrication	EEC	100	0	100	1	0	0	1
6	22NVA$07	Graphic Communication	EEC	100	0	100	1	0	0	1
7	22NVA$08	Integrated Development Environment	EEC	100	0	100	1	0	0	1
8	22NVA$09	Microsoft Office Essentials	EEC	100	0	100	2	0	0	2
9	22NVA$10	Employability Skills Training	EEC	100	0	100	2	0	0	2

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

ELECTRONICS AND INSTRUMENTATION ENGINEERING

22NMC1Z0	INDUCTION PROGRAMME	SEMESTER I

Details of the Programme:

Day 0: College Admission

Day1: Orientation Programme

Day2 Onwards: Induction Programme

Activities:
Physical activity,
Playground Events,
Yoga Practices,
Literary, Proficiency modules,
Team Building,
Lectures by Eminent people,
Familiarization to department,
Branch oriented information,
Motivational speakers,
Talent exposure,
Quiz completion,
Visit to local areas….etc.

22NHS1Z1	தமிழர் மரபு **Heritage of Tamils** (Common to all Branches)	SEMESTER I

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

UNIT – I	LANGUAGE AND LITERATURE	3 Periods

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.

UNIT – II	HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE	3 Periods

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 ofTemples in Social and Economic Life of Tamils.

UNIT – III	FOLK AND MARTIAL ARTS	3 Periods

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT – IV	THINAI CONCEPT OF TAMILS	3 Periods

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.

UNIT – V	CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE	3 Periods

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.

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).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – 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.

22NHS1Z1	தமிழர் மரபு **Heritage of Tamils** (Common to all Branches)	SEMESTER I

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

அலகு I	மொழி மற்றும் இலக்கியம்	3 Periods

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-சிற்றிலக்கியங்கள்-தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி-தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II	மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை–சிற்பக் கலை	3 Periods

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.

அலகு III	நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்	3 Periods

தெருக்கூத்து, கரகாட்டம்-வில்லுப்பாட்டு-கணியான் கூத்து-ஒயிலாட்டம்-தோல்பாவைக் கூத்து-சிலம்பாட்டம் –வளரி-புலியாட்டம் –தமிழர்களின் விளையாட்டுகள்.

அலகு IV	தமிழர்களின் திணைக் கோட்பாடுகள்	3 Periods

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு –சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் –சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V	இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு	3 Periods

இந்திய விடுதலைபோரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் – தமிழ்ப் புத்தகங்களின் அச்சு 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).
3	கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4	பொருநை – 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.

22NHS1Z2	PROFESSIONAL ENGLISH (Common to all Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	2	1	0	3

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

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

TEXT BOOK

1	***English for Science & Technology*** *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	***Communicative English,*** *Global Publishers, Chennai 2017 by Dr.J.Anbazhagan Vijay*

REFERENCES

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

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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	-	-	-	-	-
22NHS1Z2	**-**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**2**	**3**	**-**	**1**	**-**	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping:	
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

ASSESSMENT PATTERN – THEORY:							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
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

22NBS1Z1	LINEAR ALGEBRA AND CALCULUS (Common to all Branches)	SEMESTER I

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. 2. To obtain the knowledge of analyze the functions using Limits and derivative recognize the appropriate tools of differential calculus to solve applied problems. 3. To obtain the knowledge of definite and improper integration and recognize the appropriate tools of Integral Calculus to solve applied problems 4. To develop the skills in solving the functions of several variables by partial derivatives. 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.,* ***"Engineering Mathematics I"****, Tata McGraw-Hill Education(India)Pvt. Ltd, New Delhi,2015.*
2	*David C.Lay,* ***"Linear Algebra and Its Application"****, Pearson Publishers, 6th Edition, 2021.*

REFERENCES

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

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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	**PO 1**	**PO 2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO 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
22NBS1Z1	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**3**	**3**	**3**
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

22NBS1Z2	ENGINEERING PHYSICS (Common to all Branches)	SEMESTER I

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

Course Objectives	1. To understand the basics about crystal systems and defects 2. To understand the principle, characteristics, working and applications of laser and optical fiber 3. To solve problems in bending of beams 4. To solve quantum mechanical problems with the understanding of Quantum Principles 5. To understand the properties, production and applications of ultrasonic waves.

UNIT– I	**CRYSTAL PHYSICS**	**9 Periods**

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.

UNIT– II	**LASER PHYSICS AND FIBER OPTICS**	**9 Periods**

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_2 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

UNIT– III	**PROPERTIES OF MATTER**	**9 Periods**

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.

UNIT– IV	**QUANTUM PHYSICS AND APPLICATIONS**	**9 Periods**

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).

UNIT– V	**ULTRASONICS**	**9 Periods**

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

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

TEXT BOOK:

1	*K. Rajagopal, **"Engineering Physics"**,PHI Learning Private Limited, 2015.*
2	*P. K. Palanisamy, "**Engineering Physics-I**", Scitech publications Private Limited, 2015.*
3	*M. Arumugam, "**Engineering Physics**", Anuradha Publishers, 2010.*

REFERENCES:

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

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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 Analyse and solve problems in laser and optical fiber	K4
CO3	Solve problems in bending of beams Apply the knowledge in construction of buildings	K3
CO4	Explain the importance of quantum mechanics Solve problems in basic quantum physics Apply the wave equations in real time problems	K3
CO5	Explain the properties and production of ultrasonic waves 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
22NBS1Z2	**3**	**2**	-	-	-	-	-	-	-	-	-	-	**1**	-	**1**

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

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

22NES101	PROGRAMMING IN C (Common to all Branches except MECH & PRODN)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	1. To study the basic concepts of computer and programming fundamentals 2. To understand the data types in C, flow control statements, Arrays, Functions, Pointers, Structures, Unions and file concepts in C	
UNIT– I	**COMPUTER AND PROGRAMMING FUNDAMENTALS**	**9 Periods**
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		
UNIT– II	**DATATYPES AND FLOW OF CONTROL**	**9 Periods**
Structured programming – Algorithms – Structure of a C program – Variables – Data types – Operators and expressions – Input and Output statements – Tokens –Type Conversion – Control statements		
UNIT– III	**ARRAYS AND FUNCTIONS**	**9 Periods**
1D Arrays– 2D Arrays – Multidimensional Arrays – Strings – String handling functions – Functions – Recursion – Array as function arguments – Storage Classes – Enumerations.		
UNIT– IV	**POINTERS**	**9 Periods**
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()		
UNIT– V	**STRUCTURES AND UNIONS, FILE OPERATIONS**	**9 Periods**
Preprocessor directives – Structures – Unions – Bit fields – Opening and closing a file – Working with file of records – Random access to file of records.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Pradip Dey, Manas Ghosh, "**Computer Fundamentals and Programming in C**", Oxford University Press, Second Edition, 2018.*

REFERENCES:

1	*Al Kelley, Ira Pohl**,"A Book on C- Programming in C** ", 4th Edition , Addison Wesley,,2001.*
2	*Herbert Schildt , "**C: The Complete Reference**", 4thEdition, McGraw Hill Education, 2017.*
3	*Yashavant P.Kanetkar,**" Let Us C",** 15thedition, BPB Publications, 2016.*
4	*Brian W. Kernighan and Dennis Ritchie, **"The C Programming Language",** 2ndEdition, Prentice Hall Software Series, 2015.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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

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	PS O2	PSO 3
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
22NES101	**1**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping:

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

ASSESSMENT PATTERN – THEORY:

Test / Bloom's Category*	Remembering (K1)%	Understanding (K2)%	Applying (K3)%	Analyzing (K4)	Evaluating (K5)%	Creating (K6)%	Total %
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

22NMC1Z1	ENVIRONMENTAL SCIENCE AND ENGINEERING (Common to all Branches)	SEMESTER I

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

Course Objectives	1. To study the modern agriculture related problems, natural resources and its harnessing methods. 2. To study the interrelationship between living organism and environment 3. To educate the people about causes of pollutions and its controlling methods. 4. To impact the knowledge of various environmental threats and its consequences. 5. To study the various water conservation methods, Act, Population policy, Welfare programs.	
UNIT– I	**ENVIRONMENTAL ENERGY RESOURCES**	**9 Periods**
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		
UNIT– II	**ECO SYSTEM AND BIODIVERSITY**	**9 Periods**
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.		
UNIT– III	**ENVIRONMENTAL POLLUTION**	**9 Periods**
Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO_2, NO_2, H_2S, CO, CO_2 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.		
UNIT– IV	**ENVIRONMENTAL THREATS**	**9 Periods**
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.		
UNIT– V	**SOCIAL ISSUES AND ENVIRONMENT**	**9 Periods**
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.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Sharma J.P., **"Environmental Studies"**, 4th Edition, University Science Press, New Delhi 2016.*
2	*Anubha Kaushik and C.P.Kaushik**, "Environmental Science and Engineering"**, 7th Edition, New Age International Publishers, New Delhi, 2021.*

REFERENCES:

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

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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

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	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	-
22NMC1Z1	**2**	**1**	**1**	**1**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping:	
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

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	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

22NBS1Z3	PHYSICS LABORATORY (Common to all Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	0	0	3	1.5

Course Objectives	1. To impart practical knowledge on the concept of properties of matter and utilize the experimental techniques to measure the properties 2. To impart practical knowledge on the modulii of elasticity 3. To analyze the properties of semiconductors 4. To learn practically the basic electronic concepts of transistor and logic gates 5. To realize the principle, concepts and working of a solar cell and study the properties of ferromagnetic material 6. To understand the concept of quantum physics
S. No.	**LABORATORY EXPERIMENTS:**
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 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**	

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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 modulii 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

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	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
22NBS1Z3	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**

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
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

22NES1Z2	WORKSHOP PRACTICE (Common to all Branches)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	1. To make various basic prototypes in the carpentry trade such as Half Lap joint, Lap Tee joint, Dovetail joint, Mortise & Tenon joint. 2. To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint. 3. To make various mould in foundry such as Cube, Straight pipe,V pulley , and Conical bush . 4. To make various components using sheet metal such as Tray , Frustum of cone and Square box. 5. To understand the working and identify the various components of CNC Machines
S. No.	**LIST OF EXPERIMENTS**
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**	

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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
22NES1Z2	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**1**	**1**	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping :	
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

22NES103	PROGRAMMING IN C LABORATORY (Common to all Branches except MECH & PRODN)	SEMESTER I

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

Course Objectives	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.
S. No.	**EXERCISES ILLUSTRATING THE FOLLOWING CONSEPYS:**
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
Contact Periods: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**	

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Use appropriate data types and flow control statements to write C programs	K6
CO2	Write C programs using arrays , functions and command line arguments	K6
CO3	Write C programs using pointers, dynamic memory allocation and preprocess or directives	K6
CO4	Implement user defined data types using structures & union and effectively manipulate them in file operations.	K6
CO5	Develop simple applications using C	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	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
22NES103	**2**	**3**	**2**	**1**	-	-	-	-	**1**	**1**	-	1	-	-	**1**

1 – Slight, 2 – Moderate, 3 – Substantial

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

22NHS2Z4	தமிழரும் தொழில் நுட்பமும் TAMILS ANDTECHNOLOGY *(Common to all Branches)*	SEMESTER II

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

UNIT – I	WEAVING AND CERAMIC TECHNOLOGY	3 Periods
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW)– Graffiti on Potteries.		
UNIT – II	**DESIGN AND CONSTRUCTION TECHNOLOGY**	**3 Periods**
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.		
UNIT – III	**MANUFACTURING TECHNOLOGY**	**3 Periods**
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 beats - Archeological evidences - Gem stone types described in Silappathikaram.		
UNIT – IV	**AGRICULTURE AND IRRIGATION TECHNOLOGY**	**3 Periods**
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.		
UNIT – V	**SCIENTIFIC TAMIL & TAMIL COMPUTING**	**3 Periods**
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.		
Contact Periods: **Lecture: 15Periods Tutorial:0 Periods Practical:0Periods Total: 15Periods**		

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	பொருநை – 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.

22NHS2Z4	தமிழரும் தொழில் நுட்பமும் TAMILS AND TECHNOLOGY (Common to all Branches)	SEMESTER II

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

அலகு I	நெசவு மற்றும் பானைத் தொழில்நுட்பம்	3 Periods

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள்– பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II	வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்	3 Periods

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.

அலகு III	உற்பத்தித் தொழில் நுட்பம்	3 Periods

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 வகைகள்.

அலகு IV	வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்	3 Periods

அணை, ஏரி, குளங்கள் , மதகு – சோழர்காலக் குமுழித்தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார்அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு –அறிவுசார் சமூகம்.

அலகு V	அறிவியல் தமிழ் மற்றும் கணினித்தமிழ்	3 Periods

அறிவியல் தமிழின் வளர்ச்சி- கணினித்தமிழ் வளர்ச்சி- தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

Contact Periods:
Lecture: 15Periods Tutorial: 0 Periods Practical:0Periods Total: 15Periods

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	பொருநை – 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.

22NHS2Z5	VALUES AND ETHICS (Common to all Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	HSMC	3	0	0	3

Course Objectives	1. To understand and appreciate the ethical issues faced by an individual in profession, society and polity 2. To learn about Engineering Ethics and case studies 3. To understand the negative health impacts of certain unhealthy behaviors 4. To appreciate the need and importance of physical, emotional health and social health 5. To get familiar with the global issues	
UNIT– I	**BEING GOOD AND RESPONSIBLE**	**9 Periods**
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		
UNIT– II	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9 Periods**
Engineering Ethics: Senses of 'Engineering Ethics' - variety of moral issued - types of inquiry - moral dilemmas - moral autonomy - Models of Professional Roles. 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		
UNIT– III	**ADDICTION AND HEALTH**	**9 Periods**
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. Drug Abuse: Abuse of different types of legal and illegal drugs: Ethical values, causes, impact, laws and prevention		
UNIT– IV	**PROFESSIONAL ETHICS**	**9 Periods**
Abuse of Technologies: Hacking and other cyber crimes, Addiction to mobile phone usage, Video games and Social networking websites		
UNIT– V	**GLOBAL ISSUES**	**9 Periods**
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		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

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

REFERENCES:

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

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

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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

ASSESSMENT PATTERN – THEORY:							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
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

22NBS204	DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS (Common to all Branches except CSE & IT)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	1	0	4

Course Objectives	1. To gain knowledge of methods to solve higher order differential equations with constant and variable coefficients. 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. 3. To be familiar with numerical interpolation, numerical differentiation and numerical integration. 4. To acquire the knowledge of numerical solution to first order ordinary differential equations using single and multi step techniques. 5. To gain the knowledge of numerical solution to second order partial differential equations using explicit and implicit methods.	
UNIT – I	**ORDINARY DIFFERENTIAL EQUATIONS**	**9+3 Periods**
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.		
UNIT – II	**PARTIAL DIFFERENTIAL EQUATIONS**	**9+3 Periods**
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.		
UNIT – III	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION**	**9+3 Periods**
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.		
UNIT – IV	**NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS**	**9+3 Periods**
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 predicator-corrector methods.		
UNIT – V	**NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS**	**9+3 Periods**
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.		
Contact Periods: **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOK:

1	*Veerarajan.T,* ***"Engineering Mathematics"****, Revised Edition 2018, McGraw Hill Education (India) Private Limited*
2	*P. Kandasamy, K. Thilagavathy, K. Gunavathi,* ***" Numerical Methods"****, S. Chand & Company, 3rd Edition, Reprint 2013.*

REFERENCES:

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

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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
22NBS204	**3**	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**

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

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	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

22NBS205	PHYSICS OF MATERIALS	SEMESTER II

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

Course Objectives	1. To understand the properties of conducting materials 2. To understand the properties of semiconductors 3. To understand the properties of magnetic and superconducting materials 4. To explain the synthesis, characteristics, properties of nanomaterials and their applications 5. To explain the importance of thin film solar cells and their fabrication techniques

UNIT– I	**ELECTRONIC MATERIALS**	**9 Periods**

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

UNIT– II	**SEMICONDUCTORS**	**9 Periods**

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.

UNIT– III	**MAGNETIC AND SUPERCONDUCTING MATERIALS**	**9 Periods**

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

UNIT– IV	**NANOMATERIALS**	**9 Periods**

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

UNIT– V	**THIN FILM PHYSICS**	**9 Periods**

Basic of thin film growth process- epitaxy – thin film structure-substrate effect-epitaxial deposit-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.

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

TEXT BOOK:

1	*P.K.Palanisamy"**EngineeringPhysics-II**", Scitech Publications(India)pvt.Ltd, 2015*
2	*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.*

REFERENCES:

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

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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	-
22NBS205	**3**	**2**	**1**	**1**	-	-	-	-	-	-	-	-	**1**	**1**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping:	
CO1	1.1.1,1.1.2,1.2.1,1.3.1,2.1.1,2.1.3,2.4.1,2.4.2,2.4.3,2.4.4
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

ASSESSMENT PATTERN – THEORY:							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
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

22NBS206	APPLIED CHEMISTRY (Common to EEE, ECE, EIE, CSE & IT Branches)	SEMESTER II

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

Course Objectives	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.	
UNIT– I	**CHEMICAL THERMODYNAMICS**	**9 Periods**
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.		
UNIT– II	**ELECTRO CHEMISTRYAND STORAGE DEVICES**	**9 Periods**
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_2 and $Li/SOCl_2$ - Construction, working and applications. Secondary batteries- Lead acid battery and lithium-ion battery – $Li\text{-}TiS_2$- Construction, working and Applications.		
UNIT– III	**CORROSION**	**9 Periods**
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.		
UNIT– IV	**NANO MATERIALS**	**9 Periods**
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.		
UNIT– V	**FABRICATION**	**9 Periods**
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.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK:

1	*Jain. P.C. and Monica Jain, "**Engineering Chemistry**", DhanpatRai Publications Pvt Ltd, New Delhi, 16th Edition,2017.*
2	*S.S. Dara, "**A text book of Engineering Chemistry",** S. Chand Publishing, 12th Edition, 2018.*

REFERENCES:

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

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**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
22NBS206	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**1**

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

ASSESSMENT PATTERN – THEORY :							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
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

22NES204	BASICS OF CIVIL AND MECHANICAL ENGINEERING (Common all EEE & EIE Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

Course Objectives	1. To impart basic knowledge on building materials and construction practices. 2. To know the basics of Civil Engineering infrastructure development works. 3. To impart basic knowledge on Basic mechanical devices, Refrigeration and Air-conditioning systems. 4. To provide an insights to the basic conventional and non-conventional machining techniques.

PART – A CIVIL ENGINEERING

UNIT– I	BUILDING MATERIALS AND CONSTRUCTION	8 Periods

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.

UNIT– II	WATER SUPPLY AND SANITARY ENGINEERING	7 Periods

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.

UNIT– III	IRRIGATION AND TRANSPORTATION ENGINEERING	7 Periods

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

UNIT– IV	BASICS OF MECHANICAL DEVICES	8 Periods

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.

UNIT– V	REFRIGERATION AND AIR CONDITIONING SYSTEM	7 Periods

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.

UNIT– VI	METAL CUTTING PROCESSES	8 Periods

Lathe components and theirs 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., "**Basic Civil and Mechanical Engineering**", McGraw Hill Education, 2018.*
2	*Ramamrutham ., "**Basic Civil Engineering**", Dhanpat Rai Publishing Co.(P) Ltd. 2013*
3	*Venugopal K, Prabu Raja V., "**Basic Mechanical Engineering**", AnuradhaPublications, 2014.*
4	*Domkundwa S, Kothandaraman,C.P., Domkundwar A, "**Thermal Engineering**",Dhanpat Rai*

	&Co.Publishers, New Delhi, 2013.
5	*SeropeKalpakjiam., Steven R Schmid., "**Manufacturing Engineering and Technology**", Pearson Education, 7th Edition, 2018*

REFERENCES:

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

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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 transportion 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

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	2	1	3	-	-	-	-	-	1	1	2	2
CO2	2	1	1	2	-	2	1	2	-	-	-	-	-	-	3
CO3	2	1	1	1	1	3	-	1	-	-	-	1	-	2	3
CO4	3	2	1	2	2	-	2	-	-	2	-	1	1	2	-
CO5	3	2	1	2	2	-	1	-	-	2	-	1	1	-	3
22NES204	**3**	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**-**	**1**	**-**	**1**	**1**	**2**	**3**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

CO1	1.2.1,1.3.1,2.3.2,3.3.1,3.4.2,4.1.2,4.1.4,4.2.1,4.3.1,4.3.3,5.1.1,6.1.1,6.2.1,12.2.2,12.3.2
CO2	1.2.1,1.3.1,2.2.2,2.2.4,3.4.2,4.1.2,4.3.1,4.3.3,6.1.1,7.1.2,8.1.1,8.2.2
CO3	1.3.1,1.4.1,2.4.4,3.2.1,4.3.1,4.3.3,5.1.1,6.1.1,6.2.1,8.1.1,12.2.2,12.3.2
CO4	1.1.2,1.2.1,1.3.1,1.4.1,2.2.2,2.3.1,2.4.2,2.4.3,2.4.4,3.1.1,3.2.3,3.3.1,3.3.2,4.1.1,4.1.2,4.1.3, 5.1.1,5.1.2,5.2.1,5.3.1,7.1.1,7.2.1,10.1.1,10.1.2,10.3.1,12.3.1
CO5	1.1.2,1.2.1,1.3.1,1.4.1,2.2.2,2.3.1,2.4.2,2.4.3,2.4.4,3.1.1,3.2.3,3.3.1,3.3.2,4.1.1,4.1.2,4.1.3,4.2.1 5.1.1,5.1.2,5.2.1,5.3.1,7.1.1,10.1.1,10.1.2,10.3.1,12.3.1

ASSESSMENT PATTERN – THEORY :							
Test / Bloom's Category*	**Remembering (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
CAT1	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

22NBS2Z7	CHEMISTRY LABORATORY (Common to all Branches)				SEMESTER II
PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**BS**	**0**	**0**	**3**	**1.5**

Course Objectives	To inculcate the practical applications of Chemistry to students and make them apply in the fields of engineering and technology.
S. No.	**LIST OF EXPERIMENTS:**
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.	Anodiziation of aluminium.
12.	Determination of corrosion rate and inhibitor efficiency of mild steel in acid media by weight loss method.
Contact Periods: **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**	

REFERENCES:

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

COURSE OUTCOMES: Upon the completion of the course, the student will be able to		**Bloom's Taxonomy Mapped**
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	-
22NBS2Z7	**2**	**1**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

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,

22NES2Z5	ENGINEERING GRAPHICS (Common to all Branches)	SEMESTER II

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	1	0	4	3

Course Objectives	1. To understand the geometrical constructions. 2. To study the various types of projections. 3. To identify different section of solids. 4. To perform the development of surfaces and view of solids. 5. To familiarize with CAD packages.	
UNIT– I	**GEOMETRICAL CONSTRUCTIONS AND PLANE CURVES**	**3+12 Periods**
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.		
UNIT– II	**ORTHOGRAPHIC PROJECTIONS**	**3+12 Periods**
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.		
UNIT– III	**PROJECTION AND SECTION OF SOLIDS**	**3+12 Periods**
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.		
UNIT– IV	**DEVELOPMENT OF SURFACES AND ISOMETRIC PROJECTIONS**	**3+12 Periods**
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.		
UNIT– V	**COMPUTER AIDED DRAFTING**	**3+12 Periods**
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. (Demonstration purpose only, not to be included in examination).		
Contact Periods: **Lecture: 15 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 75 Periods**		

TEXT BOOK:

1	*K.Venugopal, "**Engineering Graphics**", New Age International (P) Limited, 2016.*
2	*K.V.Natarajan, "**A text book of Engineering Graphics**", Dhanalakashmi Publishers, Chennai, 2016.*

REFERENCES:

1	*K.L.Narayana and P.Kannaiah, **"Text book on Engineering Drawing"**, 2nd Edition, SciTech Publications (India) Pvt. Ltd, Chennai, 2009.*
2	*N.S.Parthasarathy and Vela Murali, **"Engineering Graphics"**, Oxford University Press, New Delhi, 2015.*
3	*K.R.Gopalakrishna, **"Engineering Drawing" (Vol. I&II combined),** Subhas Publications,*

	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, 1st Edition, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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
22NES2Z5	**3**	**1**	**1**	**1**	**1**	**2**	**-**	**3**	**1**	**3**	**1**	**3**	**1**	**1**	**2**

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

COURSE OBJECTIVE	To expose thermodynamic concepts, processes and cycles for analyzing the thermodynamic systems.	
UNIT - I	**CONCEPT OF THERMODYNAMICS**	**10 Periods**
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.		
UNIT - II	**SECOND LAW OF THERMODYNAMICS AND ENTROPY**	**10 Periods**
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.		
UNIT - III	**THERMAL SYSTEMS AND COMPONENTS**	**10 Periods**
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.		
Contact Periods: **Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods**		

TEXT BOOKS:

1	*Nag. P.K., "**Engineering Thermodynamics**", Tata McGraw Hill Company, 5th Edition, 2013.*
2	*Mahesh M Rathore., "**Thermal Engineering**" , TATA McGraw Hill Education, 1st Edition, 2010*

REFERENCES:

1	*Kothandaraman C.P., **"Thermal Engineering",** Dhanpat Rai & Sons, 1998.*
2	*YunusA Cengel, **"Thermodynamics"**,Tata McGraw Hill Company, 8th Edition, 2014*
3	*R.K. Rajput **"Engineering Thermodynamics"**, Laxmi Publications (P) Ltd, 5th Edition, 2016.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
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

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	1	-	-	-	-	-	-	-	-	-	1	-
CO2	3	3	1	1	-	-	-	-	-	-	-	-	-	1	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	-	1	-
22NES306 (A)	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**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, 2.2.3, 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

ASSESSMENT PATTERN - THEORY

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

COURSE OBJECTIVE	To acquire knowledge on the concepts of fluids, its properties ,flow equation and Hydraulic machines	
UNIT - I	**FLUID PROPERTIES AND MEASUREMENT**	**10 Periods**
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.		
UNIT - II	**EQUATIONS OF FLUID FLOW**	**10 Periods**
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).		
UNIT - III	**HYDRAULIC MACHINES**	**10 Periods**
Pumps: Classification, Construction and working principle, performance curve – centrifugal pump and reciprocating pump, submersible pump. Turbines: Classification, Construction and working principle, specific speed, and performance curve – Pelton wheel, Francis and Kaplan turbine.		
Contact Periods: **Lecture: 30 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 30 Periods**		

TEXT BOOKS:

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

REFERENCES:

1	*P.N.Modi & S.M. Seth , "**Hydraulic & Fluid Mechanics including hydraulic machines**", Standard book 2010.*
2	*Natarajan.M.K.,* "**Fluid Machines**", *Anuradha Agencies, Vidayal Karuppur, Kumbakonaam, 1995.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	1	1	-	-	-	-	-	-	-	-	1	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-	-	1	-
CO3	3	2	1	1	1	-	-	-	-	-	-	-	-	1	-
22NES306(B)	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators mapping

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

22NPC301	ELECTRICAL CIRCUITS AND NETWORKS	SEMESTER III

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

COURSE OBJECTIVE	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.	
UNIT - I	**DC CIRCUITS**	**9 +3 Periods**
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.		
UNIT - II	**TRANSIENT ANALYSIS OF CIRCUITS**	**9 +3 Periods**
Source-Free RC, RL, RLC Circuits – Standard test inputs – Response of RC, RL and RLC Circuits for step and sinusoidal excitation.		
UNIT - III	**AC CIRCUITS**	**9 +3 Periods**
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.		
UNIT - IV	**RESONANCE AND COUPLED CIRCUITS**	**9 +3 Periods**
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.		
UNIT - V	**POLYPHASE CIRCUITS AND TWO PORT NETWORKS**	**9 +3 Periods**
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 π representation - Lattice Networks.		
Contact Periods: 60 Periods **Lecture: 45 Periods Tutorial: 15 Periods Practical: 0 Periods Total: 60 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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	-	-
22NPC301	3	2	1	2	-	-	-	-	-	-	-	-	3	-	-

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, 2.1.1, 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

COURSE OBJECTIVE	To impart knowledge on the working of semiconductor devices and the operation of electronic circuits.	
UNIT - I	**PN JUNCTION DEVICES**	**9 Periods**
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.		
UNIT - II	**BIPOLAR JUNCTION TRANSISTORS**	**9 Periods**
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.		
UNIT - III	**FIELD EFFECT TRANSISTORS AND THYRISTORS**	**9 Periods**
Structure, Operation and Characteristics of JFET, MOSFET - JFET Biasing: Self and Voltage Divider Biasing - Operation and Applications of UJT, SCR, DIAC and TRIAC		
UNIT - IV	**MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER**	**9 Periods**
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).		
UNIT - V	**FEEDBACK AMPLIFIERS AND OSCILLATORS**	**9 Periods**
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.		
Contact Periods: **45 Periods** **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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	-	-
22NPC302	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**

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

22NPC303	SENSORS AND TRANSDUCERS	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
PHYSICS OF MATERIALS	PC	3	0	0	3

COURSE OBJECTIVE	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.	
UNIT - I	**CHARACTERISTICS OF TRANSDUCERS**	**9 Periods**
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		
UNIT - II	**VARIABLE RESISTANCE TRANSDUCERS**	**9 Periods**
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		
UNIT - III	**VARIABLE INDUCTANCE AND CAPACITANCE TRANSDUCERS**	**9 Periods**
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.		
UNIT - IV	**LIGHT, SEISMIC, OCCUPANCY AND MOTION DETECTION**	**9 Periods**
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.		
UNIT - V	**OTHER TRANSDUCERS**	**9 Periods**
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.		
Contact Periods: **45 Periods** **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*J. P. Bentley, **"Principles of Measurement Systems"**, Addison Wesley Longman Ltd., UK, 2010*
2	*Jacob Fraden, "**Handbook of Modern Sensors- Physics, Designs, and Applications",** Springer; 4th ed. 2010 edition*

REFERENCES:

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

5	*H. K. P. Neubert,* ***"Instrument Transducers – An Introduction to their Performance and Design",*** *Oxford University Press, Cambridge, 2009*
6	*W.Bolton,* ***"Engineering Science"****, Elsevier Newnes, Fifth edition, 2006.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Discuss the function and characteristics of transducers and measurement system.	K2
CO2	Comprehend the underpinning knowledge on the operation of a resistive type transducers and their selection for a range of real-world applications.	K2
CO3	Pick suitable inductive and capacitive transducers for a specific application.	K2
CO4	Familiarize themselves with selection of transducers for light, seismic, occupancy and motion detection.	K2
CO5	Demonstrate the understanding of the operation of modern transducers like digital, fibre optic, and range of smart sensors	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
22NPC303	**2**	**-**	**3**	**2**	**-**	**-**	**-**	**-**	**3**	**2**	**-**	**-**	**2**	**2**	**2**

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(K 4)%	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

22NPC304	ELECTRICAL AND ELECTRONIC MEASUREMENT TECHNIQUES	SEMESTER III

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	*A.K. Sawhney, Puneet Sawhney**, "A Course in Electronic and Electrical Measurements and Instrumentation"** ,S.K.Kataria & Sons, Delhi, 2014.*
2	*J. B. Gupta, "**Electronics Measurements and Instrumentation**", S.K.Kataria & Sons, Delhi, 2013.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	-	-	-	-	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	-
22NPC304	**2**	**2**	**2**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**-**

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators mapping

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

22NMC3Z2	CONSTITUTION OF INDIA (Common to All Branches)	SEMESTER III

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

COURSE OBJECTIVE	To familiarize the students on the role, powers and functions of Indian government and also understand the recent acts in India.	
UNIT - I	**INTRODUCTION AND EMERGENCY PROVISIONS**	**9 Periods**
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.		
UNIT - II	**SYSTEM OF GOVERNMENT**	**9 Periods**
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.		
UNIT - III	**UNION AND STATE GOVERNMENT**	**9 Periods**
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.		
UNIT - IV	**ORGANS OF GOVERNANCE AND RECENT ACTS**	**9 Periods**
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.		
UNIT - V	**POLITICAL DYNAMICS**	**9 Periods**
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.		
Contact Periods: **45 Periods** **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*National portal of India, "**The Constitution of India"** (Full Text), https://legislative.gov.in/constitution-of-india*
2	*Dr.B.R.Ambedkar, "**The Constitution of India",** Sudhir Prakashan, 2020.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

22NES307	ENGINEERING EXPLORATION	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	0	0	3	1.5

COURSE OBJECTIVE	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.	
UNIT - I	**INTRODUCTION**	**15 Periods**
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 21st century engineer and Graduate Attributes.		
UNIT - II	**ENGINEERING DESIGN**	**15 Periods**
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.		
UNIT - III	**ENGINEERING DISCIPLINES**	**15 Periods**
Electronics and Instrumentation Engineering: 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. Ring main wiring - Troubleshooting Electrical wiring - Dismantling and reassembling of Appliances (eg. Fans, motors etc.,) Functionalities and operational procedures of RPS/AFO/CRO/DMM/LCR meter - Functionalities and Selection of Analog and Digital meters Interpretation of Datasheets - Overview of simulation and design tools Identifying electronic components and understanding PCB glossary - Conversion of schematic into PCB layout and PCB fabrication - Practicing of soldering and desoldering - PCB trouble shooting		
Contact Periods: **45 Periods** **Lecture: 0 Periods Tutorial: 0 Periods Practical: 45 Periods Total: 45 Periods**		

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
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	-	-
22NES307	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

22NPC305	SENSORS AND MEASUREMENTS LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
• SENSORS AND TRANSDUCERS • ELECTRICAL AND ELECTRONIC MEASUREMENT TECHNIQUES	PC	0	0	3	1.5

COURSE OBJECTIVE	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,Theromcouple 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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
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	-
22NPC305	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**3**	**3**	**2**	**-**

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

22NPC306	ELECTRICAL AND ELECTRONIC CIRCUITS LABORATORY	SEMESTER III

PREREQUISITES	CATEGORY	L	T	P	C
• ELECTRICAL CIRCUITS AND NETWORKS • ANALOG ELECTRONICS	PC	0	0	3	1.5

COURSE OBJECTIVE	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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
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	-	-
22NPC306	**3**	**3**	**1**	**1**	**2**	-	-	**1**	**2**	**1**	**1**	**1**	**3**	-	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators mapping	
CO1	1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4,3.4.2,4.1.2,4.1.3, 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

22NBS408	FOURIER SERIES AND TRANSFORM CALCULUS *(Common to EEE & EIE Branches)*	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	BS	3	1	0	4

COURSE OBJECTIVE	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.	
UNIT - I	**FOURIER SERIES**	**9 + 3 Periods**
Dirichlet's Conditions – General Fourier series –Odd and even functions- Half range Sine and Cosine series – Parseval's Identity on Fourier series–Harmonic Analysis.		
UNIT - II	**BOUNDARY VALUE PROBLEMS**	**9 + 3 Periods**
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.		
UNIT - III	**LAPLACE TRANSFORMS**	**9 + 3 Periods**
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		
UNIT - IV	**FOURIER TRANSFORMS**	**9 + 3 Periods**
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.		
UNIT - V	**Z-TRANSFORMS**	**9 + 3 Periods**
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., "**Engineering Mathematics**" for III Semester, S.Chand & Co, Ramnagar, New Delhi, Revised edition 2017.*
2	*Veerarajan.T.,"**Transforms and partial Differential equations**",Tata Mc Graw Hill Publishing Co.,New Delhi, 2015*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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	-	-
22NBS408	3	2	2	3	-	-	-	-	-	-	-	1	2	-	-

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, 2.1.2, 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.

ASSESSMENT PATTERN - THEORY

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

22NES408	ELECTRICAL MACHINES	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	ES	3	0	0	3

COURSE OBJECTIVE	To impart the knowledge on principle of operation, performance, testing of different electrical machines and identify their suitability for real time applications.	
UNIT - I	**DC MACHINES**	**9 Periods**
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.		
UNIT - II	**TRANSFORMERS**	**9 Periods**
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.		
UNIT - III	**INDUCTION MACHINES**	**9 Periods**
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).		
UNIT - IV	**SYNCHRONOUS MACHINES**	**9 Periods**
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.		
UNIT - V	**SPECIAL MOTORS AND INTRODUCTION TO DRIVES**	**9 Periods**
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		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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
22NES408	3	3	1	1	1	-	-	-	-	-	-	-	2	1	1

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.2,2.4.3,2.4.4, 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

22NPC407	ELECTRONICS FOR ANALOG SIGNAL PROCESSING	SEMESTER IV

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

COURSE OBJECTIVE	To impart knowledge on the working and applications of operational amplifiers, ADCs and DACs	
UNIT - I	**IC FABRICATION AND CHARACTERISTICS**	**9 Periods**
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.		
UNIT - II	**APPLICATIONS OF OP-AMP**	**9 Periods**
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.		
UNIT - III	**COMPARATORS AND WAVEFORM GENERATORS**	**9 Periods**
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		
UNIT - IV	**SPECIAL ICs AND APPLICATION ICs**	**9 Periods**
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.		
UNIT - V	**D/A AND A/D CONVERTERS**	**9 Periods**
DAC: Weighted Resistor, R-2R Ladder, Inverted R-2R types - ADC: Flash, Counter, Servo Tracking, Successive Approximation, Dual Slope types - DAC and ADC Specifications.		
Contact Periods: **45 Periods** **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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	-
22NPC407	**3**	**3**	**1**	**1**	**1**	-	-	-	-	-	-	-	**3**	**1**	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators mapping

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

22NPC408	DIGITAL ELECTRONICS	SEMESTER IV

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

COURSE OBJECTIVE	To introduce the fundamental concepts and design of digital system	
UNIT - I	**BOOLEAN ALGEBRA AND LOGIC FAMILIES**	**9 Periods**
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.		
UNIT - II	**COMBINATIONAL CIRCUITS**	**9 Periods**
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.		
UNIT - III	**SYNCHRONOUS SEQUENTIAL CIRCUITS**	**9 Periods**
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.		
UNIT - IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS, ALGORITHMIC STATE MACHINE AND MEMORY DEVICES**	**9 Periods**
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.		
UNIT - V	**INTRODUCTION TO VHDL**	**9 Periods**
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.		
Contact Periods: **45 Periods** **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Morris Mano M, Michael D Ciletti, "**Digital Design with an Introduction to Verilog HDL**", Pearson Education International, Sixth Edition, 2018.*
2	*Anand Kumar, "**Fundamentals of Digital Circuits**", Prentice Hall of India, Fourth Edition 2016.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	1	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	1	1	-	-	-	-	-	-	-	-	3	-	-
CO3	2	3	1	1	-	-	-	-	-	-	-	-	3	-	-
CO4	1	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	2	3	1	1	-	-	-	-	-	-	-	-	3	-	-
22NPC408	2	3	1	1	-	-	-	-	-	-	-	-	3	-	-

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, 2.1.1, 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

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

22NPC409	INDUSTRIAL INSTRUMENTATION	SEMESTER IV

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

COURSE OBJECTIVE	To impart the concepts and terminologies involved in the measurement of industrial parameters	
UNIT - I	**TEMPERATURE MEASUREMENT**	**9 Periods**
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.		
UNIT - II	**PRESSURE MEASUREMENT**	**9 Periods**
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.		
UNIT - III	**MEASUREMENT OF FLOW**	**9 Periods**
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.		
UNIT - IV	**LEVEL MEASUREMENT**	**9 Periods**
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.		
UNIT - V	**MEASUREMENT OF VISCOSITY, HUMIDITY, MOISTURE AND DENSITY**	**9 Periods**
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.		
Contact Periods: **45 Periods** **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Patranabis D, **"Principles of Industrial Instrumentation"** Third Edition, McGraw Hill Education Pvt. Ltd., 2016.*
2	*William C. Dunn, **"Fundamentals of Industrial Instrumentation and Process Control"**, Second Edition, McGraw Hill Education Pvt. Ltd., 2018.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy 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
22NPC409	**2**	**2**	**1**	**3**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**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, 2.1.1, 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

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

22NPC410	FUNDAMENTALS OF SIGNALS AND SYSTEMS	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
• LINEAR ALGEBRA AND CALCULUS • FOURIER SERIES AND TRANSFORM CALCULUS	PC	3	0	0	3

COURSE OBJECTIVE	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.	
UNIT - I	**INTRODUCTION TO CONTINUOUS TIME SIGNALS(CT) AND SYSTEMS**	**9 Periods**
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.		
UNIT - II	**ANALYSIS OF CT SIGNALS**	**9 Periods**
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.		
UNIT - III	**DISCRETIZATION SIGNAL RECONSTRUCTION**	**9 Periods**
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.		
UNIT - IV	**CLASSIFICATION AND ANALYSIS OF DISCRETE TIME (DT) SIGNALS**	**9 Periods**
DT signals:–Introduction, Definition, Elementary DT signals, Characterization. DT systems: Definition, Classification, Characterization. Time Domain Analysis:-Solutions of Difference Equations		
UNIT - V	**TRANSFORM TECHNIQUES FOR DT SIGNALS AND SYSTEMS**	**9 Periods**
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	*P. Ramesh Babu & R. Anandanatarajan, **"Signals and System"**, Scitech Publications (India) Pvt Limited, 2007.*
2	*Tarun Kumar Rawat, **"Signals and System",** Oxford University Press,2010.*
3	*Proakis,J.G.,& Manolakis,D.G.,**"Digital Signal Processing:Principles and Algorithms, & Applications"**,3rd Edition, Prentice Hall of India,2007.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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	-	-
22NPC410	3	3	2	3	1	-	-	-	-	-	-	-	3	-	-

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, 1.1.4, 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

22NPC411	ANALOG AND DIGITAL CIRCUITS LABORATORY	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
• ELECTRONICS FOR ANALOG SIGNAL PROCESSING • DIGITAL ELECTRONICS	PC	0	0	3	1.5

COURSE OBJECTIVE	To provide hands on experience on working with analog and digital circuit design

LIST OF EXPERIMENTS

1. Realization of Boolean expressions using basic and universal gates
2. Design and implementation of combinational circuits
3. Design and implementation of flip flops using logic gates
4. Design and Implementation of registers
5. Design and Implementation of counters
6. Design and Implementation of synchronous sequential circuit
7. Design and Implementation of mathematical operations using operational amplifier
8. Design of Instrumentation amplifier
9. Implementation of voltage and current regulators
10. Realization of a stable multivibrator using 555 Timer
11. Design and implementation of active filters
12. Design and Implementation of ADC and DAC
13. Design and Implementation of Oscillators using Opamp
14. Simulation of circuits using software tools

Contact Periods: **45 Periods**

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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) 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

22NPC412	VIRTUAL INSTRUMENTATION LABORATORY	SEMESTER IV

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

COURSE OBJECTIVE	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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
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
22NPC412	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	1.1.1,1.1.2,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2,2.4,2.3.2,2.4.1,2.4.2,3.1.1,3.1.4,3.2.1,4.3.14.3.3, 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

22NPC513	CONTROL SYSTEM DESIGN	SEMESTER V

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

COURSE OBJECTIVE	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.	
UNIT - I	**MODELING OF SYSTEMS**	**9 +3 Periods**
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.		
UNIT - II	**TRANSIENT AND STEADY STATE ANALYSIS**	**9 +3 Periods**
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.		
UNIT - III	**STABILITY ANALYSIS IN TIME AND FREQUENCY DOMAIN**	**9 +3 Periods**
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.		
UNIT - IV	**COMPENSATORS DESIGN**	**9 +3 Periods**
Design specifications- compensator configuration (series and feedback)-design of cascade compensators (lag, lead, lag-lead) using bode plot-PID controllers.		
UNIT - V	**STATE SPACE REPRESENTATION**	**9 +3 Periods**
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.J. Nagarath and M.Gopal, "**Control Systems Engineering**", New Age International (P) Ltd., Publishers,4th Edition, 2017.*
2	*Benjamin C.Kuo, "**Automatic Control Systems**", PHI Learning Private Ltd, 7th edition,2014*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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
22NPC513	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**1**	**2**	**1**

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

22NPC514	FUNDAMENTALS OF DIGITAL SIGNAL PROCESSING	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
22NPC410- FUNDAMENTALS OF SIGNALS AND SYSTEMS	PC	3	0	0	3

COURSE OBJECTIVE	• To analyze DFT techniques, design IIR and FIR digital filters and familiarize with Digital signal processors.	
UNIT - I	**DIGITAL SIGNAL PROCESSING**	**9 Periods**
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.		
UNIT - II	**DISCRETE FOURIER TRANSFORM**	**9 Periods**
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.		
UNIT - III	**DESIGN OF IIR FILTERS**	**9 Periods**
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.		
UNIT - IV	**FIR FILTER DESIGN**	**9 Periods**
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.		
UNIT - V	**DSP PROCESSORS**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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	-
22NPC514	3	3	2	2	-	-	-	-	-	-	-	-	3	1	-

b)CO and Key Performance Indicators mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.2.3, 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, 3.2.3,3.1,4.4,3.2.3,4.3.3
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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

22NPC515	MICROPROCESSORS, MICROCONTROLLERS AND INTERFACING	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
22NPC408 DIGITAL ELECTRONICS	PC	3	0	0	3

COURSE OBJECTIVE	To introduce the fundamental concepts, interfacing and applications of microprocessors and microcontrollers.	
UNIT - I	**8085 AND 8086 MICROPROCESSORS**	**9 Periods**
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		
UNIT - II	**8051 MICROCONTROLLER**	**9 Periods**
8051 Microcontroller : Architecture , Instruction Set , Addressing Modes , Interrupts - Assembly Language Programming : Programming 8051 Timers, Serial Port Programming, Interrupts Programming.		
UNIT - III	**PERIPHERAL INTERFACING AND COMMUNICATION INTERFACES**	**9 Periods**
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^2C SPI and USB.		
UNIT - IV	**PIC MICROCONTROLLER**	**9 Periods**
PIC Microcontroller : Architecture , Instruction set ,Timers, Interrupts, Serial Ports, Assembly Language Programming : Input / Output Port Programming – PIC Programming in C		
UNIT - V	**AVR MICROCONTROLLER**	**9 Periods**
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		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Deshmhmukh L M,* ***"Microcontrollers (Theory and applications)",*** *McGraw-Hill, 7th Edition, 2008*
2	*Rajkamal* ***"Microcontrollers (Architecture, programming, interfacing and system design)",*** *Pearson Education, 2nd Edition, 2011*

REFERENCES:

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

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 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

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	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
22NPC515	2	1	1	-	-	-	-	-	-	-	-	-	3	1	1

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	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

22NPC516	PRINCIPLES OF COMMUNICATION SYSTEMS	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
1. 22NPC302 ANALOG ELECTRONICS 2. 22NPC407 ELECTRONICS FOR ANALOG SIGNAL PROCESSING 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,* ***"Communication Systems",*** *John Wiley Inc, 5th Edition, 2009.*
2	*J.S.Beasley & G.M.Miler,* ***"Modern Electronic Communication",*** *Pearson Education, 9th Edition, 2013.*

REFERENCES:

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

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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 / 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

22NPC517	INDUSTRIAL HYDRAULICS AND PNEUMATICS	SEMESTER V

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

COURSE OBJECTIVE	To provide exposure to the basics of hydraulic and pneumatic circuits for various engineering applications	
UNIT - I	FLUID POWER PRINCIPLES	9 Periods
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.		
UNIT - II	HYDRAULIC SYSTEM COMPONENTS	9 Periods
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.		
UNIT - III	CONTROL OF HYDRAULIC SYSTEMS	9 Periods
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.		
UNIT - IV	PNEUMATIC SYSTEMS	9 Periods
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.		
UNIT - V	DESIGN AND SELECTION OF PNEUMATIC CIRCUITS	9 Periods
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Anthony Esposito "**Fluid Power with Applications**", Pearson education, 7th edition, 2014*
2	*Andrew Parr "**Hydraulics & Pneumatics**", Jaico Publishing House, 3rd edition, 2011.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		Bloom's Taxonomy Mapped
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

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

22NPC518	CONTROL SYSTEM DESIGN LABORATORY	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

COURSE OBJECTIVE	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

COURSE OUTCOMES Upon completion of the course, the students will be able to		Bloom's Taxonomy Mapped
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

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	2	2	-	-	-	1	3	3	2	3	2	1
CO2	2	2	2	1	1	-	-	-	1	2	2	2	3	2	1
CO3	2	1	2	1	2	-	-	-	1	3	3	2	2	2	1
CO4	1	1	3	1	1	-	-	-	1	2	2	2	3	2	1
CO5	3	3	3	2	2	-	-	-	1	1	1	2	3	2	1
22NPC518	**3**	**2**	**3**	**2**	**2**	**-**	**-**	**-**	**1**	**3**	**3**	**2**	**3**	**2**	**1**

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

22NPC519	MICROPROCESSORS, MICROCONTROLLERS AND INTERFACING LABORATORY	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
22NPC408 DIGITAL ELECTRONICS	PC	0	0	3	1.5

COURSE OBJECTIVE	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 µp /µc
5. Interfacing of stepper motor with µp /µc
6. Interfacing of Programmable Peripheral Interface (8255) with µp / µc
7. Seven segment display interface with µp / µc
8. Interfacing of Traffic Light Controller with µp / µc
9. Interface of display/keyboard with µp / µc
10. Programming exercises using Timer 8253
11. Programming exercises using Interrupt Controller 8259
12. Interfacing of Sensors with µp / µc

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

COURSE OUTCOMES Upon completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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) 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	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
22NPC519	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

22NPC520	INDUSTRIAL INSTRUMENTATION LABORATORY	SEMESTER V

PREREQUISITES	CATEGORY	L	T	P	C
22NPC409 INDUSTRIAL INSTRUMENTATION	PC	0	0	2	1

COURSE OBJECTIVE	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

COURSE OUTCOMES Upon completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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
22NPC520	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,

22NHS606	INDUSTRIAL MANAGEMENT AND ECONOMICS *(Common to EIE, CSE and IT Branches)*	SEMESTER VI

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

COURSE OBJECTIVE	1. To understand the role of ergonomics in organizational setting. 2. To understand the important legislations that govern organizational management. 3. To understand the microeconomic concepts and it's impact on engineering decisions and everyday life activities. 4. To understand the macroeconomic concepts and it's impact on organizations and everyday life activities. 5. To understand the role of stock markets and taxation on individual consumers and organizations.	
UNIT - I	**INDUSTRIAL MANAGEMENT**	**9 Periods**
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.		
UNIT - II	**INTRODUCTION TO THE PROVISIONS OF LEGISLATIONS GOVERNING INDUSTRIES IN INDIA**	**9 Periods**
Factories Act, Employees State Insurance Act, Workmen's Compensation Act, Sexual Harassment of women at workplace (Prevention, Prohibition & Redressal) Act.		
UNIT - III	**MICROECONOMICS**	**9 Periods**
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.		
UNIT - IV	**MACROECONOMICS**	**9 Periods**
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.		
UNIT - V	**KEY ECONOMIC INDICATORS**	**9 Periods**
Gross Domestic Product, Unemployment, Stock Market trends, Taxation.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

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*

4	*Robert Pindyck & Daniel, Rubinfeld, "**Microeconomics,"** Pearson Education, 2017*
5	*G.S.Gupta, "**Microeconomics – Theory and Applications,"** McGraw Hill Education, 2017*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	-	1
CO2	-	-	-	-	-	3	-	3	2	-	-	1	-	-	1
CO3	-	-	-	-	-	-	2	-	-	-	3	-	-	-	1
CO4	-	-	2	-	3	-	-	-	-	-	-	-	-	-	1
CO5	-	-	-	2	-	-	-	-	-	-	1	-	-	-	1
22NHS606	-	-	1	1	1	2	1	1	1	-	2	1	-	-	1

b) CO and Key Performance Indicators mapping

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

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		20	50	30			100

22NPC621	PROCESS DYNAMICS AND CONTROL	SEMESTER VI

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

COURSE OBJECTIVE	To familiarize with process modeling, characteristics of control valves, controller tuning and advanced process control.	
UNIT - I	**PROCESS MODELLING**	**9 Periods**
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.		
UNIT - II	**CONTROLLERS**	**9 Periods**
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.		
UNIT - III	**PID CONTROLLER TUNING**	**9 Periods**
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.		
UNIT - IV	**FINAL CONTROL ELEMENT**	**9 Periods**
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		
UNIT - V	**MULTI LOOP CONTROL SCHEMES AND CASE STUDY**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*George Stephanopoulos, "**Chemical Process Control – An Introduction to Theory and Practice**", 3rd edition, Prentice Hall of India, 2015.*
2	*Coughanowr, D. R., & Leblanc, "**Introductory concepts. Process Systems Analysis and Control**", 3rd Ed,TMH ltd, 2017.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	-	-	-	-	-	-	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
22NPC621	3	3	2	3	1	1	-	-	-	-	-	-	1	3	3
b)CO and Key Performance Indicators mapping															
CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.2.1,3.2.3,4.1.3,4.1.4,4.2.2,4.3.1,4.3.2,4.3.3,5.1.1,5.2.1,5.2.2														
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

22NPC622	INDUSTRIAL CONTROL SYSTEMS	SEMESTER VI

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

COURSE OBJECTIVE	To provide knowledge on various industrial automation controllers, such as PLCs, DCS and SCADA.	
UNIT - I	**PLC FUNDAMENTALS**	**9 Periods**
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		
UNIT - II	**PLC PROGRAMMING**	**9 Periods**
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.		
UNIT - III	**FIELD BUS**	**9 Periods**
Overview of OSI model - Different types of Communication Buses - MODBUS – HART Protocol - Profibus – Profinet - Foundation Fieldbus: H1 and HSE - Industrial Ethernet.		
UNIT - IV	**SCADA AND HMI**	**9 Periods**
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.		
UNIT - V	**DISTRIBUTED CONTROL SYSTEMS**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*F.D.Petruzella, "**Programmable Logic Controllers**", Tata McGraw Hill, 5th Edition, 2017.*
2	*M.P.Lukas, "**Distributed Control Systems**", Van Nostrand Reinhold Co, 1st Edition, 1986.*

REFERENCES:

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

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

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

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	-	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
22NPC622	3	2	1	-	1	-	-	-	-	-	-	-	1	2	3

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, 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

22NPC623	BASICS OF VLSI DESIGN	SEMESTER VI

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

COURSE OBJECTIVE	To familiarize the characteristics, analysis and design of CMOS logic circuits and networks for the realization of VLSI system components.	
UNIT - I	**INTRODUCTION TO VLSI DESIGN**	**9 Periods**
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		
UNIT - II	**CHARACTERISTICS AND ANALYSIS OF CMOS CIRCUITS**	**9 Periods**
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		
UNIT - III	**DESIGN OF HIGH-SPEED CMOS NETWORKS**	**9 Periods**
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		
UNIT - IV	**DESIGN OF VLSI SYSTEMS**	**9 Periods**
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		
UNIT - V	**CLOCKING, RELIABILITY AND TESTING OF VLSI SYSTEMS**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*John P. Uyemura, "**Introduction to VLSI circuits and Systems**", John Wiley and Sons, 4th edition, 2001.*
2	*N. Westeet., "**CMOS VLSI Design**", Pearson Education, 3rd Edition, 2013.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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
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
22NPC623	3	2	2	-	-	-	-	-	-	-	-	-	2	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, 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

22NPC624	PROCESS CONTROL LABORATORY	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
1. 22NPC409 INDUSTRIAL INSTRUMENTATION 2. 22NPC513 CONTROL SYSTEM DESIGN	PC	0	0	3	1.5

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

LIST OF EXPERIMENTS

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

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

COURSE OUTCOMES Upon completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	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
22NPC624	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

22NPC625	INDUSTRIAL CONTROL SYSTEMS LABORATORY	SEMESTER VI

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PC	0	0	3	1.5

COURSE OBJECTIVE	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

COURSE OUTCOMES Upon completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	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
22NPC625	3	2	2	1	1	-	-	1	2	1	-	1	1	2	3

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

22NES710	FUNDAMENTALS OF SOFT COMPUTING	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
22NPC408 - DIGITAL ELECTRONICS	ES	3	0	0	3

COURSE OBJECTIVE	• To familiarize various architectures of neural networks, concepts of fuzzy control and genetic algorithms and its hybrid schemes.	
UNIT - I	**INTRODUCTION TO NEURAL NETWORKS**	**9 Periods**
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.		
UNIT - II	**NEURAL NETWORK ALGORITHMS**	**9 Periods**
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.		
UNIT - III	**FUZZY SET THEORY**	**9 Periods**
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.		
UNIT - IV	**FUZZY CONTROLLER STRUCTURE**	**9 Periods**
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.		
UNIT - V	**HYBRID CONTROL SCHEMES**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Laurene. V, Fausett, "**Fundamentals of Neural Networks, Architecture, Algorithms, and Applications**", 1st edition ,Pearson Education, 2008.*
2	*Timothy. J, Ross, "**Fuzzy Logic with Engineering Applications**",3rd Edition, Wiley, 2010.*

REFERENCES:

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

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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
22NES710	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**	**2**	**1**

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

22NPC726	POWER ELECTRONIC DEVICES AND CIRCUITS	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
22NPC302- ANALOG ELECTRONICS	PC	3	0	0	3

COURSE OBJECTIVE	• To impart knowledge on various power electronic devices and circuits.	
UNIT - I	**POWER SEMICONDUCTOR DEVICES**	**9 Periods**
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.		
UNIT - II	**CONTROLLED RECTIFIERS**	**9 Periods**
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.		
UNIT - III	**DC CHOPPERS**	**9 Periods**
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.		
UNIT - IV	**INVERTERS**	**9 Periods**
Types of inverters - Operation of single phase, three phase (120^o and 180^o) 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.		
UNIT - V	**AC VOLTAGE CONTROLLERS**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Muhammad H. Rashid-* ***"Power Electronics - Circuits- Devices and Applications"****- Prentice Hall of India, 3rd Edition, 2005.*
2	*Ned Mohan,* ***"Power Electronics-Converter Applications and Design"****, Wiley, 3rd Edition, Reprint 2011.*

REFERENCES:

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

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	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	2	1	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	1	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	2	1	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	1	-
22NPC726	3	2	2	-	-	-	-	-	-	-	-	-	2	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, 3.1.2, 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

22NPC727	INSTRUMENTATION SYSTEM DESIGN	SEMESTER VII

PREREQUISITES:	CATEGORY	L	T	P	C
1. 22NPC407 ELECTRONICS FOR ANALOG SIGNAL PROCESSING 2. 22NPC409 INDUSTRIAL INSTRUMENTATION	PC	2	0	4	4

COURSE OBJECTIVE	To impart knowledge on the design of instrumentation systems for various industrial process variables and components.	
UNIT - I	**OVERVIEW OF OP-AMP CIRCUITS**	**6 Periods**
Analog and Digital signal conditioning – Signal level and bias changes – Linearization – Conversion - Filtering - Concept of loading and impedance matching – Op-Amp circuits for instrumentation.		
UNIT - II	**DESIGN OF FLOW AND TEMPERATURE MEASURING INSTRUMENTS**	**6 Periods**
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.		
UNIT - III	**DESIGN OF PRESSURE & LEVEL MEASURING INSTRUMENTS AND P&I DIAGRAM**	**6 Periods**
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.		
UNIT - IV	**DESIGN OF FINAL CONTROL ELEMENT**	**6 Periods**
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.		
UNIT - V	**DESIGN OF PID CONTROLLER AND LOGIC CIRCUITS**	**6 Periods**
Electronic P+I+D controllers : Design - adjustment of setpoint, bias and controller settings - Design of µp/µc based system for data acquisition and P+I+D controller. Design of logic circuits for alarm, interlocks and annunciator systems.		

LIST OF EXPERIMENTS

1. Design of Instrumentation amplifiers
2. Design of frequency selective Filters
3. Design of V/I and I/V converters
4. Design and implementation of cold junction compensation circuits for thermocouple.
5. Design of signal conditioning circuit for RTD.
6. Design of orifice plate sizing.
7. Design of rotameter.
8. Control valve sizing.
9. Design and implementation of ON/OFF controller for a temperature process.
10. Design and implementation of electronic PID controllers.
11. Design of auto/manual switch for PID controllers.
12. Design of µp/µc based P+I+D controller.
13. Design of alarm and annunciator circuits.
14. Realization of first order and second order systems with dead time using electronic circuits.
15. Piping and Instrumentation Diagram – case study

Contact Periods: 90 Periods
Lecture: 30 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 90 Periods

TEXT BOOKS:

1	*C.D. Johnson, "**Process Control Instrumentation Technology"**, Prentice Hall of India, 8th Edition, 2015.*
2	*N.A.Anderson, "**Instrumentation for Process Measurement and Control**", Berlin: Springer, 3rd Edition, 2000.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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
22NPC727	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

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, 2.4.1, 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, 2.4.1, 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	Rememberin g (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

22NEE701	ENGINEERING PROJECTS IN COMMUNITY SERVICE	SEMESTER VII

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	0	0	4	2

COURSE OBJECTIVE	• 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.

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

Validation of the solution by supervising the execution of solution - Measuring the attainment of the solution: Feedback from community

Contact Periods: **90 Periods**
Lecture: 0 Periods Tutorial: 0 Periods Practical: 60 Periods Total: 60 Periods

COURSE OUTCOMES Upon completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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
22NEE701	-	2	2	-	1	2	1	-	2	1	1	-	1	1	1

22NEE802	CAPSTONE PROJECT	SEMESTER VIII

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

COURSE OBJECTIVE	• 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.
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.	
Contact Periods: **240 Periods** **Lecture: 0 Periods Tutorial: 0 Periods Practical: 240 Periods Total: 240 Periods**	

COURSE OUTCOMES Upon completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

b) 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
22NEE802	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

22NPE$01	ADVANCED CONTROL THEORY

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

COURSE OBJECTIVE	To instill the proficiency of controller design, state variable and phase plane analysis and need of optimal control.	
UNIT - I	**CONTROLLER DESIGN AND STATE SPACE ANALYSIS**	**9 Periods**
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.		
UNIT - II	**CONTROLLABILITY AND OBSERVABILITY**	**9 Periods**
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.		
UNIT - III	**NON-LINEAR CONTROL**	**9 Periods**
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.		
UNIT - IV	**LYAPUNOV STABILITY**	**9 Periods**
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.		
UNIT - V	**OPTIMAL CONTROL**	**9 Periods**
Problem formulation – necessary conditions of optimality – state regulator problem – Matrix Riccati equation – infinite time regulator problem – output regulator and tracking problems.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Nagarath, I.J. and Gopal, M., "**Control Systems Engineering**", New Age International Publishers,2nd edition,2017.*
2	*Kirk D.E, "**Optimal control theory-an introduction**",Prentice Hall,Reprint edition, N.J. 2004.*

REFERENCES:

1	*Gopal M, "**Modern Control Theory**",Wiley Eastern Publishers,2nd edition ,1993.*
2	*Tou T.J. "**Modern control theory**" ,McGraw-Hill publications,Reprint edition, 1964.*
3	*Torkel Glad & Lennart Ljung "**Control Theory - Multi Variable and Non-linear Methods**" Taylor"s & Francis Group, ,2nd edition ,2002.*
4	*Hasan Saeed.S, "**Automatic Control Systems**" S.K. Kataria & Sons, Reprint edition,2013.*
5	*Ogata K.H "**State Space Analysis of Control Systems**",Prentice Hall Publications,1st Edition, 1967.*

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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
22NPE$01	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**1**

b) CO and Key Performance Indicators mapping	
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

22NPE$02	PROCESS MODELLING AND SIMULATION

PREREQUISITES	CATEGORY	L	T	P	C
22NPC620 - PROCESS DYNAMICS AND CONTROL	PE	3	0	0	3

COURSE OBJECTIVE	To provide the fundamentals of modelling techniques of process and simulation software for estimation.	
UNIT - I	**FUNDAMENTALS OF PROCESS MODELLING**	**9 Periods**
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.		
UNIT - II	**MODELING OF DISTRIBUTED PROCESSES**	**9 Periods**
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.		
UNIT - III	**INTRODUCTION TO PROCESS MODELLING**	**9 Periods**
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.		
UNIT - IV	**MODELLING OF INDUSTRIAL PROCESS**	**9 Periods**
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.		
UNIT - V	**SIMULATION TECHNIQUES**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Luyben W.L., "**Process Modeling, Simulation, and Control for Chemical Engineering**",7th edition,McGraw-Hill (2018)*
2	*Holland,"**Fundamentals and Modeling of Separation Processes: Absorption,Distillation**" 3rd edition , Englewood Cliffs, Prentice-Hall 2014*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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
22NPE$02	3	3	2	3	1	-	-	-	-	-	-	-	-	3	3

b) CO and Key Performance Indicators mapping

CO1	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.1,3.2.1,3.2.3,4.1.3,4.1.4,4.2.2,4.3.1,43.2,4.3.3,5.1.1,5.2.1,5.2.2
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,,3.2.3,3.4.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,43.2,4.3.3,5.1.1
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,,3.2.3,3.4.1,4.1.2,4.1.3,4.1.4,4.2.1,4.2.2,4.3.1,43.2,4.3.3,6.1
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,,3.2.3,4.1.2,4.1.3,4.1.4,4.2.2,4.3.1,43.2,4.3.3,5.1.1

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

22NPE$03	COMPUTER CONTROL OF PROCESSES

PREREQUISITES:	CATEGORY	L	T	P	C
1. 22NBS408 FOURIER SERIES AND TRANSFORM CALCULUS 2. 22NPC620 PROCESS DYNAMICS AND CONTROL	PE	3	0	0	3

COURSE OBJECTIVE	To embed the necessity and design of computer controlled process and its variants via digital control algorithms	
UNIT - I	**SAMPLED DATA CONTROL SYSTEM**	**9 Periods**
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.		
UNIT - II	**SYSTEM MODELLING AND IDENTIFICATION**	**9 Periods**
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.		
UNIT - III	**DESIGN OF DIGITAL CONTROL ALGORITHM**	**9 Periods**
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.		
UNIT - IV	**ADAPTIVE CONTROL**	**9 Periods**
Concepts: Self tuning – Gain scheduling – Model Reference Adaptive Control – Self tuning regulator - – Design of auto tuning and gain scheduling adaptive controller with examples.		
UNIT - V	**MULTI VARIABLE CONTROL SYSTEM**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

a) CO/PO Mapping

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
22NPE$03	3	3	3	-	-	-	-	-	-	-	-	-	-	3	3

b) CO and Key Performance Indicators mapping

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.

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	20	50	30				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	50	30				100
ESE	20	50	30				100

22NPE$04	SYSTEM IDENTIFICATION

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

COURSE OBJECTIVE	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,	
UNIT - I	**ESTIMATORS**	**9 Periods**
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.		
UNIT - II	**INTRODUCTION TO SYSTEM IDENTIFICATION**	**9 Periods**
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.		
UNIT - III	**IDENTIFICATION METHODS**	**9 Periods**
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.		
UNIT - IV	**MODEL ESTIMATION**	**9 Periods**
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.		
UNIT - V	**RECURSIVE SYSTEM IDENTIFICATION**	**9 Periods**
Recursive system identification. Kalman filtering and other nonlinear filters		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Torsten Soderstrom, PetreStoica, "**System Identification**", Prentice Hall International Ltd.,1st edition, 1989.*
2	*Lennart Ljung, "**System Identification: Theory for the user**", Prentice Hall,2nd edition,1999.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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
22NPE$04	**3**	**3**	**3**	**2**	**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	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

22NPE$05	NON LINEAR CONTROL

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

COURSE OBJECTIVE	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.	
UNIT - I	**PHASE PLANE ANALYSIS**	**9 Periods**
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		
UNIT - II	**DESCRIBING FUNCTION**	**9 Periods**
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		
UNIT - III	**LYAPUNOV THEORY**	**9 Periods**
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.		
UNIT - IV	**FEEDBACK LINEARIZATION**	**9 Periods**
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.		
UNIT - V	**SLIDING MODE CONTROL**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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
22NPE$05	**3**	**3**	**3**	**2**	**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	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

22NPE$06	**ADAPTIVE CONTROL** *(Common to EEE & EIE Branches)*

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

COURSE OBJECTIVE	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.	
UNIT - I	**INTRODUCTION TO ADAPTIVE CONTROL SCHEMES**	**9 Periods**
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.		
UNIT - II	**PARAMETRIC IDENTIFICATION**	**9 Periods**
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.		
UNIT - III	**SELF-TUNING REGULATOR**	**9 Periods**
Self-Tuning regulator- Deterministic indirect self-tuning regulators - Deterministic direct self-tuning regulators - Stochastic self-tuning regulators – Stochastic indirect self-tuning regulator.		
UNIT - IV	**MODEL REFERENCE ADAPTIVE SYSTEM**	**9 Periods**
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.		
UNIT - V	**TUNING OF CONTROLLERS AND CASE STUDIES**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

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

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

22NPE$07	MODEL BASED CONTROL

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

COURSE OBJECTIVE	To introduce the concept of model predictive control and adaptive control schemes.	
UNIT - I	**MODEL PREDICTIVE CONTROL SCHEMES**	**9 Periods**
Model Predictive Control - Model Predictive Control Elements - Generalized Predictive Control Scheme – Multivariable Generalized Predictive Control Scheme – Multiple Model based Model Predictive Control Scheme		
UNIT - II	**MULTI VARIABLE CONTROL**	**9 Periods**
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		
UNIT - III	**STATE SPACE BASED MODEL PREDICTIVE CONTROL**	**9 Periods**
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		
UNIT - IV	**CONSTRAINED MODEL PREDICTIVE CONTROL**	**9 Periods**
Constraints Handling: Amplitude Constraints and Rate Constraints –Constraints and Optimization – Constrained LQ Control Theory - Constrained Model Predictive Control Scheme		
UNIT - V	**ADAPTIVE CONTROL**	**9 Periods**
Adaptive Control-Gain Scheduling-Self tuning Regulators– Lyapunov Theory - Model Reference Adaptive Control – Adaptive Command Tracking – Robust Model Reference Adaptive Control Scheme		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Coleman Brosilow, Babu Joseph, **"Techniques of Model-Based Control"**, Prentice Hall, 1st Edition, 2002*
2	*E. F. Camacho, C. Bordons ,**"Model Predictive Control"**, Springer, 2st Edition, 2013.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

CO4	Analyze constrained model predictive control scheme.	K3
CO5	Design adaptive control for the given application.	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	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	2	1	-	-	-	-	-	-	-	-	-	-	3	-
22NPE$07	3	2	1	-	-	-	-	-	-	-	-	-	-	3	-

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, 2.3.1, 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

22NPE$08	MACHINE MONITORING SYSTEM

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

COURSE OBJECTIVE	To introduce the concept of condition-based monitoring for effective utilization of machines	
UNIT - I	**MACHINE CONDITION MONITORING**	**9 Periods**
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.		
UNIT - II	**VIBRATION AND NOISE MONITORING**	**9 Periods**
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		
UNIT - III	**SIGNAL PROCESSING IN MONITORING**	**9 Periods**
Time domain analysis - Frequency domain analysis : FFT analysis – Signal filtering - Cepstrum analysis – Hilbert Transform in condition monitoring		
UNIT - IV	**MACHINERY MAINTENANCE**	**9 Periods**
Maintenance strategies :Reactive, Preventive, and Predictive – Benefits of planned maintenance – Bath tub curve –Trends in Machine monitoring - Case Study : Condition Monitoring in Paper mill		
UNIT - V	**MACHINE LEARNING FOR CONDITION MONITORING**	**9 Periods**
Machine Learning: Feature extraction and feature selection methods – Feature reduction – Classification techniques – Case studies of condition monitoring in Nuclear plant components, Distillation column.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Cornelius Scheffer and Paresh Girdhar, "**Practical Machinery Vibration Analysis and Predictive Maintenance**", Newnes, 1st Edition, 2004.*
2	*A. R. Mohanty, "**Machinery Condition Monitoring: Principles and Practices"** , CRC Press, 1st Edition, 2014*

REFERENCES:

1	*Stephen Marsland, "**Machine Learning: An Algorithmic Perspective ",** 2nd edition, CRC Press, 2014*
2	*Collacot, "**Mechanical Fault Diagnosis and Condition Monitoring**", Springer, 1st Edition, 2011*
3	*Davies, "**Handbook of Condition Monitoring – Techniques and Methodology**", Chapman and Hall, 1st Edition, 1997.*
4	*BKN Rao, "**Handbook of Condition Monitoring**", Elsevier, 1st edition, 1996*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

	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
22NPE$08	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

22NPE$09	FIBER OPTICS AND LASER INSTRUMENTATION

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

COURSE OBJECTIVE	To impart knowledge on the characteristics, types and industrial application of optical fiber and Laser.	
UNIT - I	**FUNDAMENTALS OF OPTICAL FIBER**	**9 Periods**
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.		
UNIT - II	**MEASUREMENT USING OPTICAL FIBER**	**9 Periods**
Fiber optic sensors – Fiber optic instrumentation system - Different types of modulators- Measurement of Pressure, Temperature, Current, Voltage, Liquid level and Strain.		
UNIT - III	**CHARACTERISTICS OF LASER**	**9 Periods**
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).		
UNIT - IV	**MEASUREMENT USING LASER**	**9 Periods**
Measurement of Distance, Length, Velocity, Acceleration, Environmental monitoring - Material processing : Laser heating, Welding, Melting and Trimming of material – Removal and Vaporization.		
UNIT - V	**HOLOGRAPHY AND MEDICAL APPLICATIONS OF LASER**	**9 Periods**
Holography : Basic principle , Methods , Holographic interferometry and application - Holography for Non-Destructive Testing (HNDT), Medical applications of lasers , laser and tissue interaction - Laser instruments for surgery – Safety aspects		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Keiser, G., "**Optical Fiber Communication**", McGraw-Hill, 3rd Edition, 2000.*
2	*John F. Read **"Industrial Applications of Lasers"** Academic Press, 2nd Edition, 2008.*

REFERENCES:

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

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 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

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
22NPE$09	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, 3.1.5, 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	20	60	20				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	30	70					100
ESE	20	80					100

22NPE$10	**THERMAL POWER PLANT INSTRUMENTATION** *(Common to EEE & EIE Branches)*

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

COURSE OBJECTIVE	To impart knowledge on the process variables, measurements and control loops used in thermal power plants.	
UNIT - I	**METHODS OF POWER GENERATION**	**9 Periods**
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.		
UNIT - II	**MEASUREMENTS IN POWER PLANTS**	**9 Periods**
Measurement of Feed Water Flow, Air Flow, Steam Flow and Coal Flow – Drum Level Measurement – Temperature Measurement- Steam Pressure Measurement.		
UNIT - III	**ANALYZERS IN POWER PLANTS**	**9 Periods**
Analysis of Impurities in Feed Water and Steam - Oxygen Analyzer - Dissolved Oxygen Analyzer - Chromatography - pH Meter - Fuel Analyzer - Flue Gas Analyzer – Pollution Monitoring Instruments.		
UNIT - IV	**CONTROL LOOPS IN BOILER**	**9 Periods**
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.		
UNIT - V	**TURBINE AND ITS CONTROL**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Sam Dukelow, "**Control of Boilers**", Instrument Society of America, 2nd Edition, 1991.*
2	*Krishnaswamy, K. and Ponnibala.M, "**Power Plant Instrumentation**", PHI Learning Pvt. Ltd., New Delhi, 2nd Edition, 2014.*

REFERENCES:

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

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 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

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	1	-	-	-	-	-	-	-	-	-	3	-
CO3	2	1	1	1	-	-	2	-	-	-	-	-	-	3	-
CO4	2	1	1	-	-	-	-	-	-	-	-	-	-	3	-
CO5	2	1	1	1	-	-	-	-	-	-	-	-	-	3	-
22NPE$10	2	1	1	1	-	-	1	-	-	-	-	-	-	3	-

b) CO and Key Performance Indicators mapping

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

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		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

22NPE$11	INSTRUMENTATION AND CONTROL IN PETROCHEMICAL INDUSTRIES

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

COURSE OBJECTIVE	To introduce the basic concepts of unit operations and control in the petrochemical industry.	
UNIT - I	**OIL EXTRACTION AND OIL GAS PRODUCTION**	**9 Periods**
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.		
UNIT - II	**IMPORTANT UNIT OPERATIONS IN REFINERY**	**9 Periods**
Distillation Column – Thermal cracking – Catalytic Cracking – Catalytic reforming – mathematical Modeling and selection of appropriate control strategy – Alkylation – Isomerization.		
UNIT - III	**DISTILLATION COLUMNS & REACTORS**	**9 Periods**
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		
UNIT - IV	**PROCESS SAFETY**	**9 Periods**
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.		
UNIT - V	**PETROLEUM DERIVATIVES AND WASTE WATER TREATMENT**	**9 Periods**
Derivatives from methane – Methanol Production – Acetylene production – Derivatives from acetylene – Derivatives from ethylene-Derivatives from propylene - wastewater treatment : Chemical Oxidation , Reduction ,Neutralization and Precipitation		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Bela. G. LIPTAK* ***"Instrumentation in Processing Industries"*** *Chilton Book Company, 1st Edition, 2012.*
2	*Considine D.M* ***"Handbook Of Applied Instrumentation"*** *McGraw Hill, 1st Edition, 1964*

REFERENCES:

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

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 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

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	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
22NPE$11	2	1	1	-	-	-	-	-	-	-	-	-	-	2	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, 3.1.4, 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

22NPE$12	AIRCRAFT INSTRUMENTATION

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

COURSE OBJECTIVE	To preface or open the concepts of aircraft systems and familiarize with the knowledge on aircraft instruments.	
UNIT - I	**AIRCRAFT SYSTEMS**	**9 Periods**
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.		
UNIT - II	**ENGINE AND AIR CONDITIONING SYSTEMS**	**9 Periods**
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.		
UNIT - III	**AIRCRAFT CONTROL SYSTEMS**	**9 Periods**
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.		
UNIT - IV	**AIR-DATA AND GYROSCOPIC INSTRUMENTS**	**9 Periods**
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		
UNIT - V	**FLIGHT INSTRUMENTS**	**9 Periods**
Study of various types of engine instruments – Engine Speed Measurement sensors – Torque sensors – Engine fuel Indicators - Pressure measurement sensors		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*David Wyatt,* ***"Aircraft Flight Instruments and Guidance Systems",*** *Routledge, 1st Edition, 2015.*
2	*Pallet, E.H.J,* ***"Aircraft Instruments, Principles and Applications",*** *Pearson Education, 2nd Edition, 2009.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Describe the principle and working of different aircraft systems	K2

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

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	-	-	-	-	-	-	-	-	-	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
22NPE$12	3	2	1	-	-	-	-	-	-	-	-	-	1	3	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	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

22NPE$13	AUTOMOTIVE INSTRUMENTATION

PREREQUISITES	CATEGORY	L	T	P	C
22NPC303 - Sensors and Transducers	PE	3	0	0	3

COURSE OBJECTIVE	To illustrate the injection methods,application of sensors and actuators, communications and advanced technologies used in automotive field	
UNIT - I	**FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS**	**9 Periods**
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.		
UNIT - II	**IGNITION AND INJECTION SYSTEMS**	**9 Periods**
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.		
UNIT - III	**SENSORS AND ACTUATORS**	**9 Periods**
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		
UNIT - IV	**ENGINE CONTROL SYSTEM AND COMMUNICATION**	**9 Periods**
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.		
UNIT - V	**CHASSIS AND SAFETY SYSTEMS**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Tom Denton, "**Automotive Electrical and Electronics Systems**",3rd Edition, SAE International,2014*
2	*Robert Bosch "**Automotive Electric and Automotive Electronics**"5th Edition, springer, 2014.*

REFERENCES:

1	*Barry Holembeak, "**Automotive Electrical and Electronics**" ,4th edition Delmar Publishers, 2010*
2	*William Ribbens, "**Understanding Automotive Electronics An Engineering Perspective**", 7th Edition, Elsevier Butterworth Heinemann Publishers, 2012.*
3	*James D Halderman, " **Automotive Electrical and Electronics**" ,5th edition, Prentice Hall, 2013*
4	*V A W Hillier "**Fundamentals of Automotive Electronics**",2nd 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

22NPE$14	SAFETY INSTRUMENTED SYSTEMS

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

COURSE OBJECTIVE	To introduce students to the basic concepts, standards and risk analysis techniques to design a safety instrumented systems.	
UNIT - I	**INTRODUCTION**	**9 Periods**
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		
UNIT - II	**PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS**	**9 Periods**
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.		
UNIT - III	**SAFETY INTEGRITY LEVEL (SIL)**	**9 Periods**
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.		
UNIT - IV	**SYSTEM EVALUATION**	**9 Periods**
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.		
UNIT - V	**CASE STUDY**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

4	*Bela. G. LIPTAK* ***"Instrumentation in Processing Industries"*** *Chilton Book Company, 1st Edition, 2012.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

22NPE$15	SMART AND WIRELESS INSTRUMENTATION

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

COURSE OBJECTIVE	To provide adequate knowledge on smart instrumentation and wireless sensor networks and to impart knowledge on various standard protocols used in wireless instrumentation.	
UNIT - I	**SENSORS**	**9 Periods**
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.		
UNIT - II	**INTERFACING OF SENSORS AND SIGNAL CONDITIONING**	**9 Periods**
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.		
UNIT - III	**WIRELESS SENSOR NETWORK**	**9 Periods**
Frequency of Wireless communication-Development of Wireless Sensor Network based Project-Wireless sensor based on microcontroller and communication device-Zigbee Communication device.		
UNIT - IV	**WIRELESS COMMUNICATION**	**9 Periods**
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.		
UNIT - V	**WIRELESS SENSOR NETWORK APPLICATIONS**	**9 Periods**
WSN based physiological parameters monitoring system- Intelligent sensing system for emotion recognition-WSN based smart power monitoring system. Digital light processor (DLP).		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

CO4	Describe the fundamentals of wireless digital communication	K2
CO5	Design and develop applications using WSN.	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	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
22NPE$15	3	2	2	2	-	-	-	-	-	-	-	-	3	2	2

b) CO and Key Performance Indicators mapping

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	Rememberin g (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

22NPE$16	ELECTRIC VEHICLES

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

COURSE OBJECTIVE	To enhance student proficiency in electric vehicles, energy sources and hybrid vehicle principles for professional competence in the automotive sector.	
UNIT - I	**INTRODUCTION TO ELECTRIC VEHICLES**	**9 Periods**
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.		
UNIT - II	**ELECTRIC TRAINS**	**9 Periods**
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.		
UNIT - III	**ANALYSIS OF ENERGY STORAGE**	**9 Periods**
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.		
UNIT - IV	**ENERGY MANAGEMENT STRATEGIES**	**9 Periods**
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.		
UNIT - V	**BUSINESS PERSPECTIVE OF ELECTRIC VEHICLE**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*MehrdadEhsani, YiminGao, Sebatien Gay and Ali Emadi,* ***"Modern Electric, Hybrid Electric and Fuel cell vehicles: Fundamentals, Theory and Design"****, CRC press, 2016.*
2	*C. Mi, M. A. Masrur and D. W. Gao,* ***"Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives"****, John Wiley & Sons, 2018.*

REFERENCES:

1	*S. Onori, L. Serrao and G. Rizzoni,* ***"Hybrid Electric Vehicles: Energy Management Strategies"****, Springer, 2015.*
2	*James Larminie and John Loury,* ***"Electric Vehicle Technology – Explained"****, John Wiley & Sons Ltd, 2016.*
3	*Sandeep Dhameja,* ***"Electric Vehicle Battery Systems"****, Butterworth – Heinemann, 2018.*
4	*T. Denton,* ***"Electric and Hybrid Vehicles"****,Routledge, 2016.*

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	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
22NPE$16	3	2	2	1	-	-	2	-	-	-	-	-	1	1	2

b) CO and Key Performance Indicators mapping

CO1	1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.2,2.2.3,2.2.4,2.3.1,2.4.4,3.1.1, 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, 3.1.5,3.1.6,4.1.17.1.2,7.2.2

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

22NPE$17	BIOMEDICAL INSTRUMENTATION

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

COURSE OBJECTIVE	To provide an overview about the human physiological system, instrumentation system for measuring and analyzing the physiological parameters	
UNIT - I	**PHYSIOLOGY**	**9 Periods**
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..		
UNIT - II	**ELECTRO PHYSIOLOGICAL MEASUREMENT AND SAFETY**	**9 Periods**
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		
UNIT - III	**NON- ELECTRICAL PARAMETER MEASUREMENTS AND TELEMETRY**	**9 Periods**
Measurement of Blood pressure, Blood flow, Cardiac output – Plethysmography – Measurement of heart sounds – Blood gas analysers – Oximeters -Biotelemetry		
UNIT - IV	**MEDICAL IMAGING SYSTEMS**	**9 Periods**
X-ray Machine – Computer Radiography - Computed Tomography – Magnetic Resonance Imaging – Ultrasonic Imaging Systems – Positron Emission Tomography –Single Photon Emission Computer Tomography – Thermography – Endoscopy.		
UNIT - V	**ASSISTING AND THERAPEUTIC DEVICE**	**9 Periods**
Pacemakers – Defibrillators – Ventilator – Nerve and muscle stimulator – Heart lung machine – Kidney machine – Audiometers – Diathermy — Application of Lasers in biomedicine.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Leslie Cromwell,* ***"Biomedical Instrumentation and measurement"****, Prentice hall, 2nd Edition, 2015.*
2	*Khandpur. R.S* ***"Handbook of Biomedical Instrumentation",****, McGraw Hill,3rd edition, 2014.*

REFERENCES:

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

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

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
22NPE$17	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	Rememberin g (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

COURSE OBJECTIVE	To impart knowledge on biosignals and filtering techniques for feature extraction from biosignals.	
UNIT - I	**BIOSIGNAL AND SPECTRAL CHARACTERISTICS**	**9 Periods**
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.		
UNIT - II	**SPECTRAL ESTIMATION OF BIO SIGNALS**	**9 Periods**
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.		
UNIT - III	**ADAPTIVE FILTERING AND WAVELET DETECTION**	**9 Periods**
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.		
UNIT - IV	**BIOSIGNAL CLASSIFICATION AND RECOGNITION**	**9 Periods**
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.		
UNIT - V	**TIME FREQUENCY AND MULTIVARIATE ANALYSIS**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Rangaraj M. Rangayyan,* ***"Biomedical Signal Analysis-A Case Study Approach"****, Wiley IEEE Press, 2nd Edition, 2016.*
2	*Willis J. Tompkins,* ***"Biomedical Digital Signal Processing"****, Prentice Hall of India, 1st Edition, 2003.*

REFERENCES:

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

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

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 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

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	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	-
22NPE$18	**3**	**3**	**1**	**2**	-	-	-	-	-	-	-	-	**2**	**1**	-

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
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

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		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

22NPE$19	PRINCIPLES OF DIGITAL IMAGE PROCESSING

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

COURSE OBJECTIVE	To provide knowledge on digital image fundamentals and various image processing techniques in spatial and frequency domain	
UNIT - I	**DIGITAL IMAGE FUNDAMENTALS**	**9 Periods**
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.		
UNIT - II	**IMAGE ENHANCEMENT**	**9 Periods**
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.		
UNIT - III	**IMAGE RESTORATION**	**9 Periods**
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.		
UNIT - IV	**IMAGE SEGMENTATION**	**9 Periods**
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.		
UNIT - V	**IMAGE COMPRESSION**	**9 Periods**
Need for data compression - Coding redundancy – Fidelity criteria – Compression methods: Huffman, Run Length Encoding and Arithmetic coding - Coding Standards : JPEG and MPEG.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Rafael C. Gonzalez, Richard E. Woods, "**Digital Image Processing**", Pearson Education India Ltd., 4th Edition,2018.*
2	*Anil K. Jain, "**Fundamentals of Digital Image Processing**", Pearson Education India Ltd., 1st Edition, 2015.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	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	-
22NPE$19	**3**	**3**	**1**	**3**	-	-	-	-	-	-	-	-	**2**	**1**	-

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, 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

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	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

22NPE$20	MEDICAL IMAGING

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

COURSE OBJECTIVE	To impart knowledge on different types of medical imaging equipments and their significance in medical diagnostics	
UNIT - I	**MEDICAL X-RAY EQUIPMENT**	**9 Periods**
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.		
UNIT - II	**COMPUTED TOMOGRAPHY**	**9 Periods**
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.		
UNIT - III	**MAGNETIC RESONANCE IMAGING**	**9 Periods**
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.		
UNIT - IV	**NUCLEAR IMAGING SYSTEM**	**9 Periods**
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.		
UNIT - V	**RADIATION THERAPY AND RADIATION SAFETY**	**9 Periods**
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).		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Anthony B. Wolbarst, Patrizio Capasso and Andrew R. Wyant, "**Medical Imaging: Essentials for Physicians**", JohnWiley & Sons, Inc, 1st Edition, 2013.*
2	*Barton F. Branstetter, "**Practical Imaging Informatics: Foundations and Applications for Medical Imaging**", Springer, 2nd Edition, 2021.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-
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	-
22NPE$20	**2**	**3**	**1**	**1**	-	-	**2**	-	-	-	-	-	**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, 2.2.1, 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

22NPE$21	MEDICAL IMAGE PROCESSING

PREREQUISITES	CATEGORY	L	T	P	C
1. 22NPE$19 DIGITAL IMAGE PROCESSING 2. 22NPE$20 MEDICAL IMAGING	PE	3	0	0	3

COURSE OBJECTIVE	To teach the concepts and techniques for processing of medical images	
UNIT - I	**FUNDAMENTALS OF IMAGE PROCESSING**	**9 Periods**
Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationship between Pixels - Color Image Fundamentals – 2D Mathematical Preliminaries - 2D Transforms.		
UNIT - II	**MEDICAL IMAGE ENHANCEMENT**	**9 Periods**
Image Enhancement Operations – Image Noise and Modeling - Image Restoration – Image Degradation Model - Medical Image Enhancement: Spatial Domain Filters, Frequency Domain Filters.		
UNIT - III	**MEDICAL IMAGE RECONSTRUCTION**	**9 Periods**
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.		
UNIT - IV	**IMAGE SEGMENTATION AND ANALYSIS**	**9 Periods**
Image Segmentation: Pixel, Edge and Region based Segmentation - Active Contour Models - Level sets for Medical Image Segmentation - Image Representation and Analysis.		
UNIT - V	**IMAGE CLASSIFICATION AND REGISTRATION**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Geoff Dougherty, "**Digital Image Processing for Medical Applications**", Cambridge University Press, 1st Edition, 2010.*
2	*Kavyan Najarian and Robert Splerstor, "**Biomedical Signals and Image processing**", CRC Press, 2nd Edition, 2012.*

REFERENCES:

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

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

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	-	-
22NPE$21	**3**	**3**	**1**	**2**	-	-	-	-	-	-	-	-	**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, 2.2.4, 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

22NPE$22	MEDICAL ROBOTICS

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, "**Medical Robotics**", JohnWiley & Sons, Inc., 2013.*
2	*Achim Schweikard and Floris Ernst, "**Medical Robotics**", Springer, 2nd Edition, 2015.*

REFERENCES:

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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	-	-	-	-	-	-	-	-	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
22NPE$22	**3**	**3**	**2**	-	-	-	-	-	-	-	-	-	-	**3**	**1**

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, 3.1.5, 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	Rememberin g (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

22NPE$23	DIAGNOSTIC AND THERAPEUTIC EQUIPMENT

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

COURSE OBJECTIVE	To impart knowledge on medical equipment for cardiology, myology and neurology.	
UNIT - I	**CARDIAC EQUIPMENT**	**9 Periods**
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		
UNIT - II	**NEUROLOGICAL EQUIPMENT**	**9 Periods**
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		
UNIT - III	**MUSCULAR EQUIPMENT**	**9 Periods**
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).		
UNIT - IV	**PATIENT MONITORING AND BIOTELEMETRY**	**9 Periods**
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.		
UNIT - V	**SPECIAL DIAGNOSTIC TECHNIQUES**	**9 Periods**
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		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Joseph J. Carr and John M. Brown,* ***"Introduction to Biomedical Equipment Technology"****, Pearson Education, 4th Edition, 2014.*
2	*John G.Webster, "****Medical Instrumentation Application and Design"****, 4th Edition, John Wiley and Sons, New York, 2009.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	-	-	-	-	-	-	-	-	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
22NPE$23	**3**	**3**	**2**	-	-	-	-	-	-	-	-	-	-	**3**	**1**

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, 3.1.5, 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	Rememberin g (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

22NPE$24	PHYSIOLOGICAL CONTROL SYSTEMS

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

COURSE OBJECTIVE	To teach the concepts of physiological control system and its significance on biological signals	
UNIT - I	**PHYSIOLOGICAL SYSTEMS WITH FEEDBACK**	**9 Periods**
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		
UNIT - II	**STEADY STATE ANALYSIS OF PHYSIOLOGICAL SYSTEM**	**9 Periods**
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		
UNIT - III	**STABILITY ANALYSIS OF PHYSIOLOGICAL CONTROL SYSTEM**	**9 Periods**
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.		
UNIT - IV	**MODELLING OF NERVE ACTION**	**9 Periods**
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.		
UNIT - V	**PHYSIOLOGICAL SYSTEM IDENTIFICATION**	**9 Periods**
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		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	-	-	-	-	-	-	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	-
22NPE$24	**3**	**3**	**2**	**1**	-	-	-	-	-	-	-	-	**1**	**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, 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	Rememberin g (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

22NPE$25	UNIT OPERATIONS

PREREQUISITES	CATEGORY	L	T	P	C
22NPC620 PROCESS DYNAMICS AND CONTROL	PE	3	0	0	3

COURSE OBJECTIVE	To impact knowledge on common unit operations carried out in process industries.	
UNIT - I	**HEAT EXCHANGE AND EVAPORATION**	**9 Periods**
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 – Jacked pan, Horizontal tube, Short tube, Long tube, Forced circulation evaporator.		
UNIT - II	**DISTILLATION**	**9 Periods**
Concept of distillation - Boiling point diagram – Vapour liquid equilibrium - Roult's Law - Relative volatility - Methods of distillation: Simple, Flash, Fractional -Batch Distillation - Importance of reflux ratio - Azeotrope.		
UNIT - III	**ABSORPTION & EXTRACTIONS**	**9 Periods**
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.		
UNIT - IV	**CRYSTALLIZATION & DRYING**	**9 Periods**
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.		
UNIT - V	**APPLICATION IN PETROCHEMICAL, PAPER & PULP INDUSTRY**	**9 Periods**
Process flow diagram of paper and pulp industry – Batch digestor – Continuous sulphate digestor – Control problems on the paper machine. Process flow diagram of PetroChemical Industry - Gas oil separation in production platform – wet gas processing.0		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

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

REFERENCES:

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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-
22NPE$25	2	1	1	1	-	-	-	-	-	-	-	-	-	2	-

b) CO and Key Performance Indicators mapping

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.

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

22NPE$26	INTELLIGENT AUTOMATION

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

COURSE OBJECTIVE	To instill the concepts and methods of problem solving using Artificial Intelligence to attain industrial automation and control.	
UNIT - I	**INTRODUCTION TO AUTOMATION**	**9 Periods**
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.		
UNIT - II	**INTRODUCTION TO ARTIFICIAL INTELLIGENCE**	**9 Periods**
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.		
UNIT - III	**KNOWLEDGE AND REASONING**	**9 Periods**
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.		
UNIT - IV	**EXPERT SYSTEMS**	**9 Periods**
Expert Systems – Architecture, Roles of expert systems, Knowledge Acquisition – Meta Knowledge – Heuristics -MOLE, SALT. Typical Expert systems -MYCIN, DART, DENTRAL, XOON		
UNIT - V	**AI IN CONTROL SYSTEMS**	**9 Periods**
Industrial AI Applications and case studies – Applications of Industrial AI in Monitoring optimization and control – Intelligent control methods.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Elaine Rich and Kelvin Knight, "**Artificial Intelligence**",Tata McGraw Hill, 1st Edition, 2014.*
2	*M.P.Groover, "**Automation, Production Systems and Computer Integrated Manufacturing**", Pearson Education, 5th edition, 2009.*

REFERENCES:

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

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

CO4	Identify the different Expert systems.	K2
CO5	Explain the need of AI in control applications.	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	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
22NPE$26	**3**	**3**	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**1**

b) CO and Key Performance Indicators mapping	
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	Rememberin g (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

22NPE$27	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 , "**Industrial Robotics – Technology, Programming and applications**" 2nd Edition,McGraw Hill, 2012.*
2	*Jazar, "**Theory of Applied Robotics: Kinematics, Dynamics and Control**", Springer India reprint, 2010.*

REFERENCES:

1	*Ganesh.S.Hedge,"**A textbook of Industrial Robotics**", Lakshmi Publications, 2006*
2	*Fu K.S. Gonalz R.C. and ice C.S.G."**Robotics Control, Sensing, Vision and Intelligence**", 3rd edition,McGraw Hill, 2007.*
3	*YoramKoren, "**Robotics for Engineers**", 2nd edition,McGraw Hill., 2002.*
4	*Janakiraman P.A., "**Robotics and Image Processing**",4th edition, Tata McGraw Hill 2005.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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

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	-	-	-	-	-	-	-	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
22NPE$27	2	2	1	1	-	-	-	-	-	-	-	1	-	2	1

b) CO and Key Performance Indicators mapping

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

22NPE$28	**INDUSTRIAL INTERNET OF THINGS** *(Common to ECE & EIE Branches)*

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

COURSE OBJECTIVE	To impart students the underpinning knowledge on the architecture, key technology enablers, protocols , and artificial intelligence for Industrial IoT and their use cases.	
UNIT - I	**INTRODUCTION TO IIoT**	**9 Periods**
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		
UNIT - II	**IIoT ARCHITECTURE**	**9 Periods**
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		
UNIT - III	**COMMUNICATION PROTOCOLS FOR IIoT**	**9 Periods**
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		
UNIT - IV	**AI and IIoT**	**9 Periods**
IIoT Analytics - Steps in Data Analytics - IIoT Basic operation using AI, ML and DL-, Overview of IoT platforms for industries:Adafruit,Thingspeak and ThingWorx.		
UNIT - V	**INDUSTRIAL IoT USE CASES**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Sudip Misra, Chandana Roy, Anandarup Mukherjee,* ***"Introduction to Industrial Internet of Things and Industry 4.0****", CRC Press, 1st edition, 2021*
2	*ArshdeepBahga, Vijay Madisetti,* ***"Internet of Things-A hands-on approach"****, Universities Press, 2015.*

REFERENCES:

1	*Andrew Minteer,* ***"Analytics for the Internet of Things (IoT): Intelligent analytics for your intelligent devices"****, Packt Publishing, 1st edition, July 2017.*
2	*Olivier Hersent, David Boswarthick, and Omar Elloumi, "****The Internet of Things: Key Applications and Protocols"****, Wiley Publications-2011*
3	*Alasdair Gilchrist,* ***"Industry 4.0: The Industrial Internet of Things",*** *Apress, 2017.*
4.	*Shriram K. Vasudevan (Author), Abhishek S. Nagarajan (Author), R. M. D. Sundaram (Author)Internet of Things,* **"Internet of Things",** *Wiley Publications, 2nd Edition,2020*

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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$28	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	40	10			100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2		50	40	10			100
ESE	10	90					100

22NPE$29	DATA ANALYTICS FOR IoT

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

COURSE OBJECTIVE	To introduce students the concept of Big Data Analytics and its relevance to IoT	
UNIT - I	**INTRODUCTION TO TECHNOLOGICAL DEVELOPMENTS IN IoT**	**9 Periods**
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.		
UNIT - II	**CLOUD ANALYTICS ENVIRONMENT**	**9 Periods**
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.		
UNIT - III	**GENERAL STRATEGIES ON EXTRACTING VALUE FROM DATASETS**	**9 Periods**
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.		
UNIT - IV	**SOCIETAL IMPACT OF MULTIMEDIA BIG DATA**	**9 Periods**
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		
UNIT - V	**APPLICATION ENVIRONMENTS**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Andrew Minteer, "**Analytics for the Internet of Things (IoT): Intelligent analytics for your intelligent devices**", Packt Publishing, 1st edition, July 2017.*
2	*Sudeep Tanwar, Sudhanshu Tyagi, Neeraj Kumar, "**Multimedia Big Data Computing for IoT Applications:Concepts, Paradigms and Solutions**", Springer, 2020.*

REFERENCES:

1	*John Soldatos, "**Building Blocks for IoT Analytics**", River Publishers Series In Signal, Image and Speech Processing, 2017.*
2	*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.*
3	*Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," **Big Data and The Internet of Things Enterprise Information Architecture for A New Age**", Apress, 2015.*

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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$29	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	Rememberin g (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

22NPE$30	IoT FOR SMART CITIES

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

COURSE OBJECTIVE	To introduce students the implementation of IoT for Smart Cities	
UNIT - I	**INTRODUCTION TO IoT FOR SMART CITIES**	**9 Periods**
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		
UNIT - II	**TECHNOLOGIES FOR IoT**	**9 Periods**
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		
UNIT - III	**AI FOR SMART CITIES**	**9 Periods**
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		
UNIT - IV	**TRANSPORTATION SYSTEM IN SMART CITY**	**9 Periods**
Tra□c 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		
UNIT - V	**SECURITY AND PRIVACY IN SMART CITY**	**9 Periods**
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		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Waleed Ejaz, Alagan Anpalagan,* ***Internet of Things for Smart Cities: Technologies, Big Data and Security****, 1st ed. Springer International Publishing, 2019.*
2	*Stimmel, Carol L,* ***Building smart cities: analytics, ICT, and design thinking****, Taylor & Francis, 2016.*

REFERENCES:

1	*Vincenzo Piuri, Rabindra Nath Shaw, Ankush Ghosh, Rabiul Islam,* ***AI and IoT for Smart City Applications, Springer****, 2022.*
2	*Al-Turjman, Fadi,* ***Intelligence in IoT-enabled smart cities****, CRC Press, 2019*
3	*Arpan Kumar Kar, M P Gupta, P. Vigneswara Ilavarasan, Yogesh K. Dwivedi,* ***Advances in smart cities : smarter people, governance and solutions,*** *CRC Press, 2017.*
4	*Hammi, B., Khatoun, R., Zeadally, S., Fayad, A., & Khoukhi, L.* ***IoT technologies for smart cities,*** *2018.*
5	*Joel J. P. C. Rodrigues, Parul Agarwal, Kavita Khann,* ***IoT for Sustainable Smart Cities andSociety****, 2022.*

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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$30	2	-	3	2	-	-	-	-	3	2	-	-	2	2	2

b) CO and Key Performance Indicators mapping

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	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

22NPE$31	BUILDING AUTOMATION

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

COURSE OBJECTIVE	To introduce students the important principles, components and practices in the Building Automation System	
UNIT - I	**INTELLIGENT BUILDINGS AND BUILDING AUTOMATION SYSTEM**	**9 Periods**
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.		
UNIT - II	**HVAC AND CONTROL OF AIR- CONDITIONING SYSTEMS**	**9 Periods**
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. 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.		
UNIT - III	**ENERGY MANAGEMENT SYSTEM**	**9 Periods**
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.		
UNIT - IV	**SAFETY SYSTEM**	**9 Periods**
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.		
UNIT - V	**BAS COMMUNICATION STANDARDS AND INTEGRATED SYSTEMS**	**9 Periods**
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		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Shengwei Wang,* ***Intelligent Buildings and Building Automation****, 2009*
2	*Reinhold A. Carlson Robert A. Di Giandomenico,* ***Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lighting, Building****,1st edition (R.S. Means Company Ltd), (1991).*

REFERENCES:

1	*Roger W. Haines,* ***"HVAC system Design Handbook",*** *5th edition*

2	*National Joint Apprenticeship & Training Committee, Building Automation System Integration With Open Protocols: System Integration With Open Protocols*
3	*John I. Levenhagen and Donald H. Spethmann,* ***HVAC Controls and Systems (Mechanical Engineering)*** *, 1992.*
4	*James E.Brumbaugh,* ***"HVAC fundamentals"****, vol: 1 to 3.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Explain the concept of intelligent building and Building Automation System	K2
CO2	Choose suitable hardware and design of HVAC in building automation system	K2
CO3	Discuss the concept of the energy management system.	K2
CO4	Analyze the safety system for building	K3
CO5	Comprehend various communication standards in BAS and develop Integrated system-building automation.	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	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$31	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	Rememberin g (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

22NPE$32	SMART FARMING

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

COURSE OBJECTIVE	To introduce students the important principles, components and practices in the smart farming technology	
UNIT - I	**INTRODUCTION**	**9 Periods**
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.		
UNIT - II	**MACHINE LEARNING IN AGRICULTURE**	**9 Periods**
Machine Learning in Agriculture- Deep Learning in Agriculture- Yield prediction- Weed Detection- Irrigation Management - Discrimination between Weed and Crop- Forecasting stages		
UNIT - III	**IoT IN AGRICULTURE**	**9 Periods**
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		
UNIT - IV	**DRONES IN AGRICULTURE**	**9 Periods**
Agricultural Drones: Types of Drones and Classifications – Definitions and Terminologies- Study of Natural Resources and Vegetation- Mapping and Monitoring.		
UNIT - V	**AGRICULTURE 5.0**	**9 Periods**
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		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

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 Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

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$32	2	-	3	2	-	-	-	-	3	2	-	-	2	2	2
b) CO and Key Performance Indicators mapping															
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	Rememberin g (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

22NPE$33	TRANSDUCER ENGINEERING

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

COURSE OBJECTIVE	To provide comprehensive knowledge on various types of transducers.	
UNIT - I	**CHARACTERISTICS OF TRANSDUCERS**	**9 Periods**
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.		
UNIT - II	**RESISTIVE TRANSDUCERS**	**9 Periods**
Operating Principle, working of Potentiometers – Metal and semiconductor strain gauges and signal conditioning circuits – Gauge factor –Resistance thermometer - RTD – Thermistor – Hot wire Anemometer –Applications.		
UNIT - III	**INDUCTANCE AND CAPACITANCE TRANSDUCERS**	**9 Periods**
Operating Principle, working of Self and mutual inductive transducers: LVDT, RVDT, Synchro's - Capacitive transducers -Microphone - Proximity sensors - Applications		
UNIT - IV	**OTHER TRANSDUCERS**	**9 Periods**
Piezoelectric transducers and their signal conditioning – Magneto strictive transducers - Digital Transducer – Elastic Transducers - Photoelectric transducers – Hall effect sensors – Basics of Gyroscope.		
UNIT - V	**ADVANCED TRANSDUCERS**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*J. P. Bentley, **"Principles of Measurement Systems"**, Addison Wesley Longman Ltd., 2010.*
2	*Jacob Fraden, **"Handbook of Modern Sensors- Physics, Designs, and Applications"**, Springer; 4th edition. 2010.*

REFERENCES:

1	*Shawney A K, **"A course in Electrical and Electronic Measurements and Instrumentation"**, Dhanpat Rai and Sons. 19th revised edition, 2013.*
2	*E. O. Doeblin, **"Measurement Systems: Applications and Design"**, Tata McGraw-Hill Book Co,2017.*
3	*D. Patranabis, "**Sensors and Transducers"**, Prentice Hall India Pvt. Ltd, 2007.*
4	*S.M. Sze, **" Semiconductor sensors"**, John Wiley & Sons Inc., 1994.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

	transducers	
CO5	Elucidate the operation of modern transducers for diverse applications.	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	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
22NPE$33	3	2	2	1	-	-	-	-	-	-	-	-	-	3	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, 3.1.2, 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

22NPE$34	PRINCIPLES OF ELECTRICAL AND ELECTRONIC MEASUREMENTS

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

COURSE OBJECTIVE	To impart knowledge on measurement of various electrical parameters and waveform analysis.	
UNIT - I	**ELECTRICAL MEASUREMENTS**	**9 Periods**
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.		
UNIT - II	**MEASUREMENT OF POWER & ENERGY**	**9 Periods**
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.		
UNIT - III	**MEASUREMENT OF R, L, C**	**9 Periods**
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.		
UNIT - IV	**DIGITAL MEASUREMENT OF ELECTRICAL QUANTITIES**	**9 Periods**
Concept of digital measurement - Block diagram of digital voltmeter - Digital multimeter - Digital LCR meter - Digital wattmeter and energy meters.		
UNIT - V	**WAVEFORM ANALYZER**	**9 Periods**
CRO – DSO - Function generator - Waveform analyzers - Spectrum analyzers - Harmonic distortion analyzer.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Kalsi.H. S,* ***"Electronic Instrumentation"****, Tata McGraw Hill Education Private Limited, 3rd Edition, 2012.*
2	*Shawney A K,* ***"A course in Electrical and Electronic Measurements and Instrumentation",*** *Dhanpat Rai and Sons. 19th revised edition, 2013.*

REFERENCES:

1	*David A. Bell,* ***"Electronic Instrumentation and Measurements"****, Oxford University Press, 3rd Edition, 2013.*
2	*Golding, E.W. and Widdis, F.C.,* ***"Electrical Measurements and Measuring Instruments"****, A.H. Wheeler and Co, 5th Edition, 2011.*
3	*Cooper, W.D. and Helfric, A.D.,* ***"Electronic Instrumentation and Measurement Techniques"****, Prentice Hall, 1st Edition, 2009.*
4	*M B Stout,* ***"Basic Electrical Measurements"****, Literary Licensing, LLC, 2012.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

CO4	Measure electrical quantities using digital meters.	K2
CO5	Summarize the operation and working of various waveform analyzers.	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	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	-
22NPE$34	2	2	1	1	-	-	-	-	-	-	-	-	2	2	-

b) CO and Key Performance Indicators mapping

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	1.2.1,1.3.1,1.4.1,1.2.1.2,2.1.3,2.2.1,2.3.2, 2.4.3, 3.1.1,3.1.2,3.1.4.4.1.2

ASSESSMENT PATTERN - THEORY

Test/Bloom's Category	Rememberin g (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

22NPE$35	FIELD INSTRUMENTATION

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

COURSE OBJECTIVE	To impart knowledge on field instrumentation encompassing temperature, pressure, level, flow, viscosity, humidity, and moisture measurements.	
UNIT - I	**TEMPERATURE MEASUREMENT**	**9 Periods**
Introduction to temperature measurements – Thermocouple – Resistance Temperature Detector – Thermistor and its measuring circuits – Radiation pyrometers and thermal imaging - Temperature IC sensor LM35.		
UNIT - II	**PRESSURE MEASUREMENT**	**9 Periods**
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.		
UNIT - III	**FLOW MEASUREMENT**	**9 Periods**
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.		
UNIT - IV	**LEVEL MEASUREMENT**	**9 Periods**
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.		
UNIT - V	**MEASUREMENT OF VISCOSITY, HUMIDITY, MOISTURE**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Ernest.O. Doebelin and Dhanesh.N. Manik, **"Doebelin's Measurement Systems"**, McGraw Hill Education, 6th Edition, 2011.*
2	*Patranabis D, **"Principles of Industrial Instrumentation"**, Tata McGraw Hill, 3rd Edition, 2010.*

REFERENCES:

1	*B.G. Liptak, **"Process Measurement and Analysis"**, CRC Press, 4th Edition, 2003*
2	*Douglas M. Considine, **"Process / Industrial Instruments & Controls Handbook"**, McGraw Hill, Singapore, 5th Edition, 1999.*
3	*William C. Dunn, **"Fundamentals of Industrial Instrumentation and Process Control"**, McGraw Hill Education Pvt. Ltd., 2nd Edition,2018.*
4	*S. K. Singh,**"Industrial Instrumentation and Control"**, Tata Mc Graw Hill Education Pvt. Ltd., 3rd Edition, 2009.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	-	-	-	-	-	-	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	-
22NPE$35	2	2	1	1	-	-	-	-	-	-	-	-	1	3	-

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, 2.4.3,3.1.1, 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

ASSESSMENT PATTERN - THEORY

Test/Bloom's Category	Rememberin g (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

22NPE$36	PROCESS CONTROL

PREREQUISITES	CATEGORY	L	T	P	C
22NPE$35 FIELD INSTRUMENTATION	PE	3	0	0	3

COURSE OBJECTIVE	To impart knowledge on industrial process control.	
UNIT - I	**INTRODUCTION**	**9 Periods**
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.		
UNIT - II	**PROCESS MODELLING**	**9 Periods**
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.		
UNIT - III	**FINAL CONTROL ELEMENT**	**9 Periods**
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.		
UNIT - IV	**CONTROLLER MODES**	**9 Periods**
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.		
UNIT - V	**MULTI LOOP CONTROLLERS**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*G. Stephanopoulos,* ***"Chemical Process Control-An Introduction to Theory and Practice"****. Prentice Hall of India, New Delhi, 3rd Edition,2008..*
2	*D.R. Coughanowr, Steven E LeBlanc,* ***"Process Systems Analysis and Control"****, McGraw Hill, Singapore, 3rd Edition,2009*

REFERENCES:

1	*D.E. Seborg, T.E. Edgar, D.A. Mellichamp.* ***"Process Dynamics and Control"****, Wiley India Pvt. Ltd., 4th Edition.2016.*
2	*B.W. Bequette,* ***"Process Control Modeling, Design and Simulation",*** *Pearson 2nd Edition,2023.*
3	*C.A. Smith and A.B Corripio.,* ***"Principles and Practice of Automatic Process Control"****, John Wiley and Sons, New York, 3rd Edition,2005.*
4	*Bela G. Liptak,* ***"Instrument Engineers' Handbook, Volume II: Process Control and Optimization"****, CRC Press, 4th Edition,2005.*

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 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

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	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
22NPE$36	3	2	2	1	-	-	-	-	-	-	-	-	1	3	1

b) CO and Key Performance Indicators mapping

CO1	1.1.1,1.2.1,1.3.1,1.4.1,2.1.1,2.1.2,2.1.3,2.2.1,2.2.3, 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

ASSESSMENT PATTERN - THEORY

Test/Bloom's Category	Rememberin g (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

22NPE$37	INDUSTRIAL AUTOMATION SYSTEMS

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

COURSE OBJECTIVE	To provide knowledge on different industrial automation controllers such as DCSs, PLCs, and SCADA	
UNIT - I	**INTRODUCTION TO AUTOMATION**	**9 Periods**
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.		
UNIT - II	**COMPUTER AIDED MEASUREMENT AND CONTROL**	**9 Periods**
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.		
UNIT - III	**FUNDAMENTALS OF PLC**	**9 Periods**
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.		
UNIT - IV	**PLC PROGRAMMING, SELECTION AND INSTALLATION**	**9 Periods**
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.		
UNIT - V	**DISTRIBUTED CONTROL SYSTEM**	**9 Periods**
Overview of DCS - DCS software configuration - DCS communication -DCS Supervisory Computer Tasks - DCS integration with PLC and Computers - Features and Advantages of DCS.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*F.D.Petruzella, "**Programmable Logic Controllers**", Tata McGraw Hill, 5th Edition, 2017.*
2	*Krishna Kant, "**Computer - Based Industrial Control**", Prentice Hall, 2nd Edition, 2011.*

REFERENCES:

1	*Bela.G.Liptak, "**Process Software and Digital Networks – Volume 3**", CRC Press, 4th Edition, 2012*
2	*G.Clarke, D.Reynders and E.Wright, "**Practical Modern SCADA Protocols:DNP3, 60870.5 and Related Systems**", Newnes, 1st Edition, 2004.*
3	*IDC Technologies, "**Practical Distributed Control Systems (DCS) for Engineers and Technicians**" 2012.*
4	*M.P.Lukas, "**Distributed Control Systems**", Van Nostrand Reinhold Co, 1st Edition, 1986.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	-	-	-	-	-	-	-	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
22NPE$37	3	2	1	-	1	-	-	-	-	-	-	-	1	1	3

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
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

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	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

22NPE$38	VIRTUAL INSTRUMENTATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	PE	2	0	2	3

COURSE OBJECTIVE	To impart knowledge on the concept of Virtual instrumentation, software tools, and data acquisition	
UNIT - I	**INTRODUCTION**	**6 Periods**
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.		
UNIT - II	**LabVIEW ENVIRONMENT**	**6 Periods**
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		
UNIT - III	**PROGRAMMING TECHNIQUES**	**6 Periods**
Repetition and Loops - Arrays - Clusters - Structures - Strings -Plotting Data - File I/O		
UNIT - IV	**DATA ACQUISITION**	**6 Periods**
Signal Conditioning - DAQ Hardware - DAQ Hardware Configuration – Analog I/O - Digital I/O- Counter - Timer - DAQ Software Architecture - Network Data Acquisition		
UNIT - V	**APPLICATIONS IN VARIOUS DOMAINS**	**6 Periods**
Application in various domains: Control Design, Process Control, Biomedical, Image Acquisition and Processing.		
LIST OF EXPERIMENTS 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		
Contact Periods: 60 Periods **Lecture: 30 Periods Tutorial: 0 Periods Practical: 30 Periods Total: 60 Periods**		

TEXT BOOKS:

1	*Jovitha Jerome, "**Virtual Instrumentation Using LabVIEW**", PHI Learning Pvt. Ltd, 1St Edition, 2010.*
2	*Gary Johnson, Richard Jennings, "**Lab view graphical programming**", Tata McGraw Hill, 2011.*

REFERENCES:

1	*Sanjay Gupta and Joseph John, "**Virtual Instrumentation using LabVIEW**", Tata McGrawHill, 2nd Edition, 2010.*
2	*Kevin James, "**PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control**", Newnes Publishers, 2000.*
3	*Mathivanan, N., "**PC-Based Instrumentation**", PHI Learning Pvt. Ltd, New Delhi, 2009.*
4	*Lisa K Wells and Jeffrey Travels, "**Labview for everyone**", Prentice Hall, 3rd Edition 2009.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	3	-	-	-	-	-	-	-	-	-	-
CO4	2	1	1	-	3	-	-	-	-	-	-	-	-	-	-
CO5	2	1	1	-	3	-	-	-	-	-	-	-	-	-	-
22NPE$38	2	1	1	-	3	-	-	-	-	-	-	-	-	-	-

b) CO and Key Performance Indicators mapping

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

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		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

22NPE$39	ANALYTICAL INSTRUMENTATION

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

COURSE OBJECTIVE	To impart the knowledge on the working principles of different types of analytical instruments used in the industry.	
UNIT - I	**SPECTROPHOTOMETRY**	**9 Periods**
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.		
UNIT - II	**CHROMATOGRAPHY**	**9 Periods**
General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography –Applications.		
UNIT - III	**INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS**	**9 Periods**
Gas analyzers : Oxygen, NO_2 and H_2S 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.		
UNIT - IV	**pH METERS AND DISSOLVED COMPONENT ANALYZERS**	**9 Periods**
Selective ion electrodes - Principle of pH and conductivity measurements - dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.		
UNIT - V	**NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY**	**9 Periods**
NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A, "**Instrumental methods of analysis**", 7th Edition, 2012..*
2	*Khandpur. R.S, "**Handbook of Analytical Instruments",** Tata McGraw-Hill publishing Co.Ltd., 2nd Edition 2007.*

REFERENCES:

1	*Liptak.B.G, "**Process Measurement and Analysis**", CRC Press, 5th Edition, 2015.*
2	*Ewing, G.W, "**Instrumental Methods of Chemical Analysis**",McGraw-Hill, 5th Edition Reprint 1985. (Digitized in 2007).*
3	*Braun. R.D, "**Introduction to Instrumental Analysis**",Pharma Book Syndicate,2006.*
4	*Braun, R.D., "**Introduction to Instrumental Analysis**", Pharma Book Syndicate, 2nd Edition 2016.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

	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

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	-	-	-	-	-	-	-	-	-	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	-
22NPE$39	3	2	1	-	-	-	-	-	-	-	-	-	1	3	-

b) CO and Key Performance Indicators mapping

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

22NPE$40	REAL TIME EMBEDDED SYSTEMS

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

COURSE OBJECTIVE	To elaborate the basic concepts of embedded systems and real time operating systems	
UNIT - I	**INTRODUCTION TO EMBEDDED SYSTEMS**	**9 Periods**
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		
UNIT - II	**PROCESSOR HARDWARE**	**9 Periods**
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.		
UNIT - III	**EMBEDDED PROGRAMMING**	**9 Periods**
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		
UNIT - IV	**ARM ARCHITECTURE AND PERIPHERALS**	**9 Periods**
Introduction to ARM – Architecture – **LPC2148 / LPC4088** / CortexA53 – Memory Organization – Addressing Modes - Interrupt Structure. Peripherals: I/O Ports - I/O Memory – EEPROM – SRAM – Timer – Serial Communication – **I2C / SPI / UART** - ADC and/ DAC Interfacing – Wireless – Bluetooth / **Zigbee / LoRaWAN**		
UNIT - V	**REAL TIME OPERATING SYSTEMS**	**9 Periods**
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		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Rajkamal, "**Embedded Systems Architecture, Programming and Design**", Tata McGraw Hill, 3rd Edition, 2017.*
2	*Rajib Mall, "**Real-Time systems Theory and Practice**", Pearson Education, 2007*

REFERENCES:

1	*Jonathan W. Valvano, "**Introduction to ARM Cortex Microcontroller**",Createspace Independent Publishing Platform , 5nd Edition 2017.*
2	*Silberschatz, Galvin, Gagne , "**Operating System Concepts**" , John Wiley, 9 th Edition, 2013.*
3	*Jean J. Labrosse, "**Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C**", CRC Press, 2019.*
4	*Jonathan W. Valvano, "**Embedded Microcomputer Systems, Real Time Interfacing**", Cengage Learning, 3rd, 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	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

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	3	1	-	2	-	-	-	-	-	-	1	3	-	2
CO4	2	2	1	-	2	-	-	-	-	-	-	1	3	-	2
CO5	2	2	1	-	2	-	-	-	-	-	-	1	3	-	2
22NPE$40	2	2	1	-	2	-	-	-	-	-	-	1	3	-	2

b) CO and Key Performance Indicators mapping

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

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		50	50				100
ESE	20	60	20				100

22NPE$41	**ELECTRONIC CIRCUIT DESIGN** *(Common to EEE, ECE & EIE Branches)*

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

COURSE OBJECTIVE	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 2. Emphasis the practical aspects of circuit design and analysis 3. To impart the knowledge of circuits analysis for their static and dynamic behaviour through Simulation	
UNIT - I	**INTRODUCTION TO SENSORS, POWER SUPPLY, SWITCH AND DRIVERS**	**9 Periods**
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.		
UNIT - II	**DATA CONVERTERS AND I/O INTERFACES**	**9 Periods**
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.		
UNIT - III	**SYSTEM ON CHIP**	**9 Periods**
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).		
UNIT - IV	**PMICs AND WIRED COMMUNICATIONS**	**9 Periods**
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).		
UNIT - V	**WIRELESS COMMUNICATIONS**	**9 Periods**
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,***

	***New Jersey"**, Wiley, 2011*
3	*G. Manganaro, **"Advanced Data Converters. Cambridge"**, Cambridge Univ. Press, 2012*

REFERENCES:

1	*W. A. Kester, **"Data Conversion Handbook"**, Amsterdam, Elsevier Newnes, 2005*
2	*Beuchat R D, et.al, **"Fundamentals of System-on-Chip Design on Arm Cortex-M Microcontrollers, Arm Education Media"**, Arm Education Media, 2021*
3	*Joseph Yiu, **"System-on-Chip Design with Arm Cortex-M Processors"**, Reference Book, Cambridge, ARM Education Media, 2019*
4	*Mona M. Hella, and Patrick Mercier, Eds., **"Power management integrated circuits"**, CRC Press, 2016*
5	*Forouzan B A, **"Data Communications and Networking"**, McGraw-Hill, 5th ed. India, 2017*
6	*Qizheng GU, **"RF System Design of Transceivers for Wireless Communications"**, Springer, 2015*
7	*Maniktala S, **"Power over ethernet interoperability"**, McGraw-Hill, New York, 2013.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Interpret the performance of sensors and power supplies, switches and drivers	K2
CO2	Determine the suitable data converters and I/O interfaces for specific requirement	K3
CO3	Describe the functions of components in the system on chip	K2
CO4	Choose and explain the functional blocks for PMICs and WIRED COMMUNICATIONS	K3
CO5	Analyse different wireless communication technologies	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	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
22NPE$41	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	Rememberin g (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 /Case Study 1/ Seminar 1 / Project1		30	40	30			100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2		40	40	20			100
ESE	20	40	40				100

22NPE$42	**ELECTRONIC SYSTEM DESIGN AND PRODUCTIZATION** *(Common to EEE, ECE & EIE Branches)*

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

COURSE OBJECTIVE	To introduce broad knowledge for the design, development, fabrication of electronic products, printed circuit boards and systems and its reliability and product safety	
UNIT - I	**PCB DESIGN, RULES, AND MANUFACTURABILITY**	**9 Periods**
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.		
UNIT - II	**ELECTROMAGNETIC COMPATIBILITY AND COMPLIANCE**	**9 Periods**
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.		
UNIT - III	**THERMAL MANAGEMENT FOR ELECTRONICS**	**9 Periods**
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.		
UNIT - IV	**DESIGN FOR RELIABILITY AND MANUFACTURING**	**9 Periods**
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.		
UNIT - V	**PRODUCT SAFETY, SECURITY, COMPLIANCE AND CERTIFICATION**	**9 Periods**
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. 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. Process of Certification : ISO/IEC 17065 Conformity Assessment; ISO 17011; Certifying Bodies; Standards; Marking/Certificate; Accreditation Bodies; IAF, FCC, CE, BIS, NABL.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Clyde F. Coombs and Happy Holden , "**Printed Circuits Handbook**", 7th Edition, McGraw Hill, 2016*
2	*Clayton R. Paul, "**Introduction to Electromagnetic Compatibility**", Wiley , 2nd Edition, 2010;*
3	*T. Yomi Obidi, "**Thermal Management in Automotive Applications**", SAE International, 1st Edition, 2015.*

REFERENCES:

1	*Wilson, P, "**The Circuit Designer's Companion**", Oxford Newnes, 3rd Edition, 2011*
2	*Terence Rybak and Mark Stefafika, "**Automotive EMC**", Kluwer Academic Publishers, 1st Edition, 2003.*
3	*Ralph Remsburg, "**Thermal Design of Electronic Equipment**", CRC Press, 1st Edition, 2001*
4	*Alessandro Birolini, "**Reliability Engineering: Theory and Practice**", Springer, 8th Edition, 2017.*
5	*Jan Swart,"**Electrical Product Compliance and Safety Engineering**", Artech House, 1st Edition, 2017.*
6	*J. Doherty, "**Wireless and Mobile Device Security**", Jones and Bartlett Learning, 2nd Edition, 2021.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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
22NPE$42	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,

	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

22NPE$43	PRINCIPLES OF CMOS VLSI DESIGN

PREREQUISITES	CATEGORY	L	T	P	C
1. 22NPC302 ANALOG ELECTRONICS 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^2MOS 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, "**Principles of CMOS VLSI Design**" Addison Wesley, Latest Edition*
2	*Bushnell and Agrawal, "**Essentials of VLSI Testing for digital, memory and mixed-signal VLSI Circuits**", Kluwer Academic Publishers.*

REFERENCES:

1	*Rabaey, Chandrakasan and Nikolic, "**Digital Integrated Circuit: A Design Perspective**", Prentice Hall, 2nd Edition, 2003.*
2	*Neil H.E. Weste and David Money Harris, "**CMOS VLSI DESIGN**", Pearson Education, 4th Edition, 2015.*
3	*R. Jacob Baker, "**CMOS: Circuit Design, Layout, and Simulation**", Wiley-IEEE, 4th Edition, 2019.*
4	*Wayne Wolf , Marilyn Wolf, "**Modern VLSI Design: System on Chip Design**", Pearson Education, New Delhi, 2008.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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	-	-
22NPE$43	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

22NPE$44	INDUSTRIAL DATA NETWORKS

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

COURSE OBJECTIVE	To impart students the underpinning knowledge on the data communication and widely used industrial network protocols.	
UNIT - I	**DATA COMMUNICATION FUNDAMENTALS**	**9 Periods**
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.		
UNIT - II	**SERIAL DATA COMMUNICATION PROTOCOLS**	**9 Periods**
Serial asynchronous communication protocol: RS 232 C- RS 485 - GPIB – USB - I2C		
UNIT - III	**PROTOCOLS FOR FIELD INSTRUMENTS AND CONTROLLERS**	**9 Periods**
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		
UNIT - IV	**PROTOCOLS FOR ENERGY, AUTOMOTIVE AND BUILDING AUTOMATION SYSTEMS**	**9 Periods**
IEC 60870-5-104 - DNP3 - IEC 61850 - M-Bus - SERCOS (Serial Real-time Communication System) - BACnet (Building Automation and Control Networks) - KNX - CANopen		
UNIT - V	**WIRELESS AND MISCELLANEOUS PROTOCOLS**	**9 Periods**
Bluetooth - Wi-Fi - WirelessHART - Zigbee - OPC (OLE for Process Control) - MQTT		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Data Communications and Networking, Behrouz A. Forouzan, 5th Edition, Mc Graw Hill,2017*
2	*Industrial Data Communications, Lawrence (Larry) M. Thompson and Tim Shaw , 5th Edition, ISA,2015*

REFERENCES:

1	*"Practical Industrial Data Networks: Design, Installation and Troubleshooting", Steve Mackay , Edwin Wright, Deon Reyn'ders , John Parker, Newnes,2004 y*
2	*"Industrial Network Basics", Gary D Anderson , 1st Edition, 2021*
3	*"Industrial Automation from Scratch: A hands-on guide to using sensors, actuators, PLCs, HMIs, and SCADA to automate industrial processes", Olushola Akande,1st Edition,ISBN 9781800569386, 2023*
4	*"Computer Networks ", Andrew Tanenbaum , David Wetherall, 5th Edition, Pearson,2010*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
CO1	Discuss the fundamental concepts of Data Communication	K2
CO2	Exhibit the understanding of serial communication protocols	K2

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

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	-	-	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
22NPE$44	2	-	3	2	-	-	-	-	3	2	-	-	1	2	3

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	10	90					100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	10	90					100
ESE	10	90					100

22NPE$45	MEMS AND NANOTECHNOLOGY

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

COURSE OBJECTIVE	To illustrate the fundamentals of MEMS, nanotechnology and their importance in multidisciplinary fields.	
UNIT - I	**OVERVIEW OF MEMS**	**9 Periods**
Introduction: emergence, devices and application, scaling issues, materials for MEMS, Thin film deposition, lithography and etching.		
UNIT - II	**MICROSYSTEM FABRICATION PROCESSES**	**9 Periods**
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.		
UNIT - III	**NANOTECHNOLOGY**	**9 Periods**
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.		
UNIT - IV	**MICRO AND NANO-ELECTROMECHANICAL SYSTEMS AND MICROFLUIDICS**	**9 Periods**
MEMS/NEMS: Magnetic, Chemical and Mechanical Transducers –Sensing and Actuators. Microfluidics: Laminar flow - Hagen-Peouiselle equation - basic fluid ideas, Special considerations of flow in small channels - mixing - Micro valves and micro pumps.		
UNIT - V	**INDUSTRIAL APPLICATIONS**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Tai Ran Hsu, "**Mems & Microsystem Design and Manufacture**", 3rd Edition,Tata McGraw Hill, 2017.*
2	*B.S. Murty., P. Shankar., B.Raj, et.al, "**Textbook of Nanosciences and Nanotechnology**", University Press (India) Pvt. Ltd. VCH, XII. 2013.*
3	*Bharat Bhushan, "**Handbook of Nanotechnology**", 3rd Edition, Springer, 2010.*

REFERENCES:

1	*Krzysztof Iniewski., Vikas Choudhary, "**MEMS: Fundamental Technology and Applications (Devices, Circuits, and Systems)**" , CRC press, 2013.*
2	*Marc Madou, "**Fundamentals of Micro fabrication**", The science of Miniaturization, 2nd ,CRC Press, 2017.*
3	*Julian W. Gardner and Vijay K. Varadan, "**Micro sensors, MEMS, and Smart devices**", John Wiley &Sons Ltd, 2002.*
4	*Michael Wilson, Kamali Kannangara, Geoff Smith, "**Nanotechnology, Basic Science and Emerging technologies**", Taylor & Francis Group, 2002.*
5	*Akhlesh Lakhtakia "**Hand Book of Nano Technology, Nano-meter Structure, Theory, Modelling and Simulations**", Prentice-Hall of India (P) Ltd, 2007.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

a) CO/PO Mapping

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
22NPE$45	3	1	-	1	-	-	-	-	-	-	-	-	3	-	2

b) CO and Key Performance Indicators mapping

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	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$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, "**Machine Learning**", McGraw-Hill Education (India) Private Limited,1st edition, 2017.*
2	*Stephen Marsland, "**Machine Learning: An Algorithmic Perspective**", CRC Press,2nd edition,, 2014.*

REFERENCES:

1	*Kevin P. Murphy, "**Machine Learning: A Probabilistic Perspective**", MIT Press, Illustrated edition, 2012.*
2	*Ethem Alpaydin "**Introduction to Machine Learning (Adaptive Computation and Machine Learning)**", The MIT Press,4th edition , 2020.*
3	*Laurene Fausett, " **Fundamentals of Neural Networks, Architectures, Algorithms and Applications**", Pearson Education, 2nd edition,2008 .*
4	*Christopher Bishop, "**Pattern Recognition and Machine Learning**" , Springer, 1st edition,2006*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

CO4	Describe K-nearest Neighbor and advanced Learning	K2
CO5	Apply machine learning algorithms to solve problems of moderate complexity	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$46	**3**	**3**	**3**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**1**

b) CO and Key Performance Indicators mapping

CO1	1.1.1,1.2.1,2.1.3,4.1.4,5.2.1,12.3.1
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	Rememberin g (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

22COE$01	DISASTER MANAGEMENT AND MITIGATION *(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	*Singhal J.P.* ***"Disaster Management",*** *Laxmi Publications, 2010.*
2	*Tushar Bhattacharya,* ***"Disaster Science and Management",*** *McGraw Hill India Education Pvt. Ltd., 2012.*

REFERENCES:

1	*Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005.*
2	*Government of India, National Disaster Management Policy,2009.*
3	*Gupta Anil K, Sreeja S. Nair.* ***"Environmental Knowledge for Disaster Risk Management"****, NIDM, New Delhi, 2011*
4	*Kapur Anu Vulnerable India:* ***A Geographical Study of Disasters****, IIAS and Sage Publishers, New Delhi, 2010*

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
22COE$01	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

22COE$02	**WATER SANITATION AND HEALTH** *(Common to All Branches)*

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**OE**	**3**	**0**	**0**	**3**

Course Objective	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	
UNIT – I	**INTRODUCTION**	**9 Periods**
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.		
UNIT – II	**OCCUPATIONAL HEALTH AND HYGIENE**	**9 Periods**
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.		
UNIT – III	**WORKPLACE SAFETY AND SAFETY SYSTEMS**	**9 Periods**
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.		
UNIT – IV	**HAZARDS AND RISK MANAGEMENT**	**9 Periods**
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.		
UNIT – V	**ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT**	**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	***Industrial Health and Safety Acts and Amendments**, by Ministry of Labour and Employment, Government of India.*
2	*Dr.K.U.Mistry, Siddharth Prakashan, **"Fundamentals of Industrial Safety and Health"**, 2012*

REFERENCES:

1	*Bill Taylor, **"Effective Environmental, Health, and Safety Management Using the Team Approach",** Culinary and Hospitality Industry Publications Services, 2005.*
2	*Nicholas P.Cheremisinoff and Madelyn L. Graffia, **"Environmental and Health and Safety Management"**, William Andrew Inc. NY, 1995.*
3	*Brian Gallant, **"The Facility Manager's Guide to Environmental Health and Safety"** , Government Inst Publ., 2007.*
4	*https://archive.nptel.ac.in/courses/114/106/114106017/*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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	Identity 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:

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	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	-
22COE$02	2	-	1	-	3	3	3	2	1	-	2	-	1	1	-

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

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.

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

22MOE$03	NANOTECHNOLOGY AND SURFACE ENGINEERING *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To educate the production techniques and characterization techniques of nano materials and to familiarize about the surface modification techniques using nano materials.	
UNIT – I	**ELEMENTS OF NANO-SCIENCE AND NANOTECHNOLOGY**	**(9 Periods)**
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.		
UNIT – II	**NANOTECHNOLOGY AND CERAMICS**	**(9 Periods)**
Introduction, Vapor Condensation Methods, Sputtering, Laser Method, Spray Pyrolysis, Thermo Chemical /Flame Decomposition of metal organic Precursors methods		
UNIT – III	**CHARACTERIZATION OF NANOMATERIALS**	**(9 Periods)**
X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy, UV / Visible Spectroscopy.		
UNIT – IV	**SURFACE ENGINEERING**	**(9 Periods)**
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.		
UNIT – V	**SURFACE MODIFICATION TECHNIQUES**	**(9 Periods)**
Surface modification by use of directed energy beams, Plasma, Sputtering & Ion Implantation. Surface modification by Friction stir processing. Surface composites.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*G. Cao,* ***"Nanostructures and Nanomaterials: Synthesis",*** *Properties and Applications by Imperial College Press, 2nd edition, 2011.*
2	*Keith Austin "****Surface Engineering Hand Book"****, London : Kogan Page, 1998*

REFERENCES:

1	*Gregory Timp, "****Nanotechnology",*** *Springer, 2012*
2	*Dheerendra Kumar Dwivedi,* ***"Surface Engineering: Enhancing Life of Tribological Components"****, Springer, 2018*
3	*D. Phil Woodruff,****"Modern Techniques of Surface Science****", Cambridge University Press, 2016*
4	*Sulabha K. Kulkarni ,****"Nanotechnology: Principles and Practices****", Springer, 2019*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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:

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	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
22MOE$03	-	1	2	1	1	-	-	-	-	-	1	-	2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

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

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	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

22MOE$04	**INDUSTRIAL SAFETY MANAGEMENT** *(Common to All Branches)*

PREREQUISITES	**CATEGORY**	**L**	**T**	**P**	**C**
NIL	**OE**	**3**	**0**	**0**	**3**

Course Objective	To learn the techniques of industrial safety and management to implement and solve safety problems in engineering.	
UNIT – I	**ENVIRONMENT AND SAFETY PHILOSOPHY**	**(9 Periods)**
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		
UNIT – II	**SAFETY APPRAISAL AND CONTROL TECHNIQUES**	**(9 Periods)**
Plant and equipment safety appraisal techniques – Laws and regulation – Hazards and Risks – Major accident hazard control – Importance of Disaster management		
UNIT – III	**ACCIDENT PREVENTION AND SAFETY MANAGEMENT**	**(9 Periods)**
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.		
UNIT – IV	**SAFETY MANAGEMENT IN INDUSTRIES**	**(9 Periods)**
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.		
UNIT – V	**INDUSTRIAL HYGIENE AND POLLUTION CONTROL**	**(9 Periods)**
Industrial Hygiene – Air sampling – Noise and vibration – Industrial physiology - Occupational health – Personal Protective Equipment's – Pollution Control strategies.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Akhil Kumar Das**, "Principles of Industrial Safety Management":Understanding the Ws of Safety at Work"** PHI Learning , 2021*
2	*Jain R K and Sunil.S.Rao**, "Industrial Safety Health and Environment Management System"**, Seventh reprint, Khanna publishers, 2023.*

REFERENCES:

1	*Prathibha Bansal and Anupama Prashar,* ***"Industrial safety and Environment"****, S.K.Kattaria Sons, 2005.*
2	*A.K.Gupta,* ***"Industrial safety and Environment"****, Laxmi Publication Pvt Limited, 2008.*
3	***"Accident Prevention Manual For Industrial Operations****", N.S.C Chicago, 13th Edition 2009.*
4	*Dan Petersen,* ***"Techniques of Safety Management****", Americal Society of Safety Emgineers, 4th edition, 2003.*

COURSE OUTCOMES: On completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Understand Environment and safety philosophy.	K1
CO2	Frame Safety appraisal and control technique to create safety management.	K2
CO3	Follow accident prevention procedure to solve safety problem.	K2
CO4	Implement safety management for Industries.	K3
CO5	Follow Industrial Hygiene and Pollution control	K3

COURSE ARTICULATION MATRIX:

a) CO and PO Mapping															
COs/POs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	1	3	-	-	-	-	-	-	-	3	1	2
CO2	3	3	-	1	2	-	-	-	-	-	-	-	3	2	2
CO3	3	3	-	-	3	-	-	-	-	-	-	-	3	1	2
CO4	3	3	-	1	2	-	-	-	-	-	-	-	3	2	2
CO5	3	3	-	-	3	-	-	-	-	-	-	-	3	1	2
22MOE$04	3	3	-	1	3	-	-	-	-	-	-	-	3	1	2
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, 2.1.3, 2.2.1, 2.2.3, 2.2.4, 2.4.4, 4.3.4, 5.1.2, 5.2.1, 5.2.2, 5.3.1, 5.3.2														
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, 2.4.3, 2.4.4, 4.1.4, 5.1.2, 5.2.1, 5.3.1, 5.3.2														
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, 2.4.3, 2.4.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 5.3.2														
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, 2.4.3, 2.4.4, 4.1.4, 5.1.2, 5.2.1, 5.3.1, 5.3.2														
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, 2.4.3, 2.4.4, 5.1.1, 5.1.2, 5.2.1, 5.3.1, 5.3.2														

ASSESSMENT PATTERN							
Test / Bloom's Category*	**Rememberin g (K1) %**	**Understanding (K2) %**	**Applying (K3) %**	**Analyzing (K4) %**	**Evaluating (K5) %**	**Creating (K6) %**	**Total %**
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

22EOE$05	RENEWABLE POWER GENERATION SYSTEMS *(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. 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. 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_2; 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 OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
CO1	Describe the environmental aspects of renewable energy resources in comparison with various conventional energy systems, their prospects and limitations.	K2
CO2	Summarize the use of solar energy and the various components used in the energy production with respect to applications like - heating, cooling, desalination, electric power generation.	K2
CO3	Apply the conversion principles of wind and tidal energy for the production of electric power generation	K3
CO4	Apply the concept of biomass energy resources and green energy for developing sustainable electric power generation set-up	K3
CO5	Analyze the basic knowledge of ocean thermal energy conversion and hydrogen energy and hence design & evaluate the power generation system	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**	**PSO 1**	**PSO 2**	**PSO 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
22EOE$05	3	3	3	3	3	3	3	-	-	-	-	3	3	3	2
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping (Times New Roman, Size 11)	
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.

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.

ASSESSMENT PATTERN – THEORY							
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	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

22EOE$06	SMART GRID TECHNOLOGY *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	To provide a comprehensive understanding of Smart Grid Technology, including its components, functions, applications and implications for Energy Management and Distribution.	
UNIT – I	**BASICS OF POWER SYSTEMS**	**9 Periods**
Basics of Power Systems: Load and Generation - Power Flow Analysis- Economic Dispatch and Unit Commitment Problems. Smart Grid: Definition – Applications- Government and Industry- Standardization		
UNIT – II	**SMART GRID COMMUNICATIONS**	**9 Periods**
Two-way Digital Communications Paradigm - Network Architectures - IP-based Systems - Power Line Communications - Advanced Metering Infrastructure		
UNIT – III	**WIDE AREA MEASUREMENT**	**9 Periods**
Sensor Networks - Phasor Measurement Units- Communications Infrastructure- Fault Detection and Self-Healing Systems -Applications and Challenges		
UNIT – IV	**SECURITY AND PRIVACY**	**9 Periods**
Cyber Security Challenges in Smart Grid - Load Altering Attacks- False Data Injection Attacks- Defense Mechanisms - Privacy Challenges- Cyber Security Standards		
UNIT – V	**ECONOMICS AND MARKET OPERATIONS**	**9 Periods**
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		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

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.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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
22EOE$06	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	1.1.1,1.1.2,1.2.1,1.3.1,1.4.1,2.1.2,2.1.3,2.2.1,2.2.3,2.3.1,2.3.2,2.4.1,2.4.2,2.4.3,2.4.4,3.1.6,3.2.13.2.2,3.2.3,4.1.1,4.1.3,4.1.4,5.1.1,5.2.1,5.3.1,8.2.2,9.1.2,7.2.1,7.2.2,6.2.1,6.1.1,5.3.2,5.3.1,5.3.212.1.2,12.2.2,12.3.2,
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

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

22LOE$07	**CMOS VLSIDESIGN** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To introduce various aspects of CMOS logic design in combinational and sequential circuit to design CMOS VLSI system components	
UNIT – I	**CMOSLOGICDESIGN**	**9 Periods**
Inverter- CMOS Logic Gates: Compound Gates – Pass Transistors and Transmission Gates –Tristated – Multiplexers –CMOS Fabrication and Layout: Fabrication Process – Layout Designrule–GateLayouts–Stick Diagrams–Design Partitioning.		
UNIT – II	**MOSTRANSISTORTHEORY**	**9 Periods**
Introduction – Long Channel I-V Characteristics – C-V Characteristics – Non-ideal I-V Effects –DC Transfer Characteristics – CMOS Technologies – Sources of Power Dissipation - DynamicPower–Static Power.		
UNIT – III	**COMBINATIONALCIRCUITDESIGN**	**9 Periods**
CircuitFamilies:StaticCMOS–RatioedCircuits–CascodeVoltageSwitchLogic–Dynamic Circuits–PassTransistorCircuits.Silicon-on-InsulatorCircuitDesign–SubthresholdCirucitDesign.		
UNIT – IV	**SEQUENTIALCIRCUITDESIGN**	**9 Periods**
Sequentialstaticcircuits–Circuitdesignoflatchedandflip-flops–Sequencingdynamiccircuits –Synchronizers–Wavepipelining -VLSIclocking:CMOS clockingstyles-Pipelinedsystems-Clockgenerationanddistribution.		
UNIT – V	**DESIGNOFVLSISYSTEMS**	**9 Periods**
System Specifications – Structural Gate Level Modeling – Switch Level Modeling – BehavioralandRTL Modeling-Addition/subtraction–Comparators–counters—Multiplexers-BinaryDecoders – Comparators – Priority Encoders – Latches - Flip-Flops and Registers – SRAM –DRAM–ROM.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*N. Weste and David Money Harris, "**CMOS VLSI Design**", Fourth Edition, PearsonEducation,2011*
2	*Uyemura, John P, "**Introduction to VLSI Circuits and Systems**", Wiley & Sons, 8th Reprint 2009*

REFERENCES:

1	*JanM.Rabaey,"**DigitalIntegratedCircuits:ADesignPerspective**",PHI,SecondEdition,2012.*
2	*R.JacobBaker,"**CMOS:CircuitDesign,Layout,andSimulation**",Wiley-IEEE,RevisedSecondEdition,2008.*
3	*Pucknell,"**BasicVLSIDesign**",PrenticeHall,2006.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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 :

a) CO and PO Mapping															
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
22LOE$07	**3**	**3**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**-**	**3**	**3**	**1**	**3**
1 – Slight, 2 – Moderate, 3 – Substantial															

b) CO and Key Performance Indicators Mapping	
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

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		50	50				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2		50	50				100
ESE	40	40	20				100

22LOE$08	**MOBILE COMMUNICATION** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	To understand and recall the mobile radio propagation, cellular architectures, equalization and diversity techniques, digital modulation techniques and various wireless network standards.	
UNIT – I	**MOBILE RADIO PROPAGATION**	**9 Periods**
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.		
UNIT – II	**CELLULAR CONCEPT**	**9 Periods**
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.		
UNIT – III	**MULTIPATH MITIGATION TECHNIQUES**	**9 Periods**
Equalization – Adaptive equalization: Linear and Non-Linear equalization, - Diversity – Micro and Macro diversity - Diversity combining techniques - Rake receiver- MIMO Coding: Alamouti Scheme (Qualitative)		
UNIT – IV	**MODULATION TECHNIQUES**	**9 Periods**
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		
UNIT – V	**WIRELESS NETWORKS**	**9 Periods**
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.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Theodore S. Rappaport, "Wireless communications", 2nd Edition, Pearson Education, 2010*
2	*Mischa Schwartz, "Mobile Wireless Communications", 1st 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", 1st Edition, Cambridge University Press, 2006.*
3	*Andreas.F. Molisch, "Wireless Communications", 2nd Edition, Wiley, 2011.*
4	*Aditya K Jagannatham, "Principles of Modern Wireless Communication Systems Theory and Practice", 1st Edition, McGraw Hill Education (India) Private Limited, 2017*
5	*William Stallings, "Wireless Communications and networks", 2nd Edition, Pearson, 2009.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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/ 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	-	-	-	-	-	-	-	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
22LOE$08	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 Category*	Remembering (K1) %	Understanding (K2) %	Applying (K3) %	Analyzing (K4) %	Evaluating (K5) %	Creating (K6) %	Total %
CAT1	20	40	20	20			100
CAT2	50	50					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	50	50					100
ESE	20	40	20	20			100

22POE$09	**RAPIDPROTOTYPING** *(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: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods		

TEXT BOOK:

1	*Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani "**Additive manufacturing technologies".** 3rd edition Springer Cham, Switzerland, 2021.*
2	*Andreas Gebhardt and Jan-Steffen Hötter "**Additive Manufacturing: 3D Printing for Prototyping and Manufacturing**", Hanser publications, United States, 2015.*

REFERENCES:

1	*Andreas Gebhardt, **"Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing"**, Hanser Gardner Publication, Cincinnati., Ohio, 2011.*
2	*Milan Brandt, **"Laser Additive Manufacturing: Materials, Design, Technologies, and***

	***Applications"**, Woodhead Publishing., United Kingdom, 2016.*
3	*Amit Bandyopadhyay and Susmita Bose, **"Additive Manufacturing",** 1st Edition, CRC Press., United States, 2015.*
4	*Kamrani A.K. and Nasr E.A., **"Rapid Prototyping: Theory and practice",** Springer., United States ,2006.*
5	*Liou, L.W. and Liou, F.W., **"Rapid Prototyping and Engineering applications: A tool box for prototype development"**, CRC Press., United States, 2011.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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	-	-	-
22POE$09	**2**	**2**	**3**	**2**	**3**	**1**	**3**	-	**3**	**3**	**2**	**3**	-	-	-

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.

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

22POE$10	**MANAGERIALECONOMICS** *(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.		
Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods		

TEXT BOOK:

1	*Maheshwari.Y* ***"Managerial Economics",*** *Prentice Hall of India, 2012*
2	*Thomas and Maurice* ***"Managerial Economics: Concept and Applications",*** *McGrawHill, 2005*

REFERENCES:

1	*D.N. Dwivedi,* ***"Managerial Economics",*** *Vikas Publishing house, 2015*
2	*Christopher R Thomas, S Charles Maurice,* ***"Managerial economics",*** *Mcgraw Hill, 2014*
3	*M. A. Beg, "****Managerial Economics****",Global Professional Publishing Ltd, 2010*
4	*K.C. Sankaranarayanan, "****Managerial Economics****", CBS, 2015*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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
22POE$10	**1**	**3**	**2**	**3**	**1**	**3**	**3**	**-**	**1**	**3**	**3**	**3**	**-**	**1**	**2**

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

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	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

22NOE$11	MEASUREMENT AND CONTROL *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

COURSE OBJECTIVE	To teach about the concepts of variable sensors for industrial parameter measurement and to impart knowledge on automatic control system	
UNIT - I	**INTRODUCTION TO MEASUREMENTS**	**9 Periods**
Elements of measurement system - Classification of Instruments – Static and dynamic characteristics of a measurement system - Errors in measurement - Calibration of instruments.		
UNIT - II	**STRAIN AND DISPLACEMENT MEASUREMENT**	**9 Periods**
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.		
UNIT - III	**PRESSURE AND TEMPERATURE MEASUREMENT**	**9 Periods**
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.		
UNIT - IV	**FLOW AND LEVEL MEASUREMENT**	**9 Periods**
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 .		
UNIT - V	**AUTOMATIC CONTROL SYSTEM**	**9 Periods**
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.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

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, 3rd Edition, 2016.*

REFERENCES:

1	*William Bolton, "****Instrumentation and Control Systems****,'' Newnes, Publication, 3rd Edition, 2021.*
2	*E. D. Doeblin,* ***"Measurement Systems: Application and Design",*** *McGraw Hill Publication, 6th Edition, 2017.*
3	*E.W. Golding and F.C. Widdis,* ***"Electrical Measurements and Measuring Instruments"*** *A.H.Wheeler and Co., 5th Edition, 2011.*
4	*Alan S. Morris,* ***"Measurement and Instrumentation Principles",*** *Butterworth-Heinemann Publications, 3rd Edition, 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	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

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	-	-	-	-	-	-	-	-	-	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
22NOE$11	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	-	-	**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, 2.3.1, 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

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	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

22NOE$12	**INDUSTRIAL AUTOMATION** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

COURSE OBJECTIVE	To elaborate on the basic concept of automation, including the necessary components and various automation controllers utilized in industrial automation.	
UNIT - I	**INTRODUCTION TO AUTOMATION**	**9 Periods**
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.		
UNIT - II	**AUTOMATION COMPONENTS**	**9 Periods**
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.		
UNIT - III	**PROGRAMMABLE LOGIC CONTROLLERS**	**9 Periods**
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.		
UNIT - IV	**DISTRIBUTED CONTROL SYSTEM**	**9 Periods**
Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers.		
UNIT - V	**SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEMS**	**9 Periods**
Introduction - Supervisory Control and Data Acquisition Systems – SCADA HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.		
Contact Periods: 45 Periods **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS:

1	*Frank D. Petruzella, "**Programmable Logic Controllers**", 5th Edition, McGraw Hill, 2016.*
2	*S.K. Singh "**Industrial Instrumentation and Control**", 3rd Edition, McGraw Hill Companies, 2004.*

REFERENCES:

1	*Sudip Misra, Chandana Roy, Anandarup Mukherjee, **"Introduction to Industrial Internet of Things and Industry 4.0**", CRC Press, 1st edition, 2021*
2	*Bela G Liptak, "**Process software and digital networks – Volume 3**", 4th Edition, CRC press, 2012.*
3	*Romily Bowden, "**HART application guide and the OSI communication foundation**",1999.*
4	*John.W. Webb Ronald A Reis, "**Programmable Logic Controllers - Principles and Applications**", Prentice Hall Inc., 5th Edition, 2003.*
5	*M. P. Lukcas, "**Distributed Control Systems"**, Van Nostrand Reinhold Co., 1986.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	-	-	-	-	-	-	-	-	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
22NOE$12	3	3	2	1	-	-	-	-	1	-	-	1	1	3	3

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, 2.3.1, 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.

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	60	20				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2	20	60	20				100
ESE	20	60	20				100

22SOE$13	PROGRAMMING IN JAVA *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	The objective of this course is to provide students with the essential Java constructs necessary for developing an object-oriented program.	
UNIT – I	**FUNDAMENTALS OF JAVA PROGRAMMING**	**9 Periods**
History and Evolution of Java- Overview of java– Operators- Control Structures– Methods- Classes and Objects– Inheritance- Packages and Interfaces- Exception Handling.		
UNIT – II	**THREADS , I/O AND STRING HANDLING**	**9 Periods**
Multi threaded Programming– Enumeration- Auto boxing– Annotations- String Handling-Input/Output: Exploring java.io		
UNIT – III	**EVENT HANDLING**	**9 Periods**
Introducing the AWT: working with windows- graphics and text- Using AWT controls- Layout Manager - Menus - Introducing Swing		
UNIT – IV	**IMAGING AND DATABASE CONNECTIVITY**	**9 Periods**
Imaging: Creating- loading and displaying- Image observer- Double buffering- Media tracker- Image producer– consumer– filters– animation- Java Database Connectivity		
UNIT – V	**NETWORKING**	**9 Periods**
Networking – Remote Method Invocation – Java Beans –Java servlets		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOKS

1	*Herbert Schildt, "Java**, The Complete Reference** ", Tata McGrawHill, 12th Edition, 2022*

REFERENCES

1	*Deitel .H.M and Deitel.P.J, " **Java: How to Program** ", Pearson Education Asia, 9th Edition 2011*
2	*Lay.S&Horstmann Gary Cornell, " **Core Java Vol I** ", The Sun Microsystems & press Java Series, 9th Edition, 2012*
3	*NPTEL Course : "**PROGRAMMING IN JAVA"*** ***https://archive.nptel.ac.in/courses/106/105/106105191/***

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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

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
22SOE$13	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 /Case Study 1/ Seminar 1 / Project1			70	30			100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2			50	50			100
ESE		30	40	30			100

22SOE$14	NETWORK ESSENTIALS *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objectives	The objective of the course is to understand the basics of networking and able to configure and troubleshoot switches and routers.	
UNIT – I	**INTRODUCTION**	**9 Periods**
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		
UNIT – II	**WIRELESS NETWORKING**	**9 Periods**
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		
UNIT – III	**ADDRESSING AND ROUTING FUNDAMENTALS**	**9 Periods**
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		
UNIT – IV	**ROUTING PROTOCOLS**	**9 Periods**
Static Vs Dynamic Routing Protocols – Distance vector Routing – Link State Routing – Hybrid Routing – Configuring RIP - Network Services – DHCP, DNS - Analyzing Internet Traffic.		
UNIT – V	**TROUBLESHOOTING AND NETWORK SECURITY**	**9 Periods**
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.		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Jeffrey S.Beasley Piyasat Nilkaew "**Network Essentials**" 3 rd Edition, Pearson, 2018*
2	*Larry L. Peterson and Bruce S. Davie "**Computer Networks, A Systems Approach**" 5 th edition, Morgan Kaufmann Publishers Inc, 2014.*

REFERENCES :

1	*Behrouz A. Forouzan, "**Data Communications and Networking with TCP/IP Protocol Suite**", Sixth Edition TMH, 2022.*
2	*James F. Kurose, Keith W. Ross, "**Computer Networking, A Top-Down Approach Featuring the Internet**", Eighth Edition, Pearson Education, 2021.*
3	*Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "**Computer Networks: An Open Source Approach**", McGraw Hill, 2012.*
4	*Nader F. Mir, "**Computer and Communication Networks",** Second Edition, Prentice Hall, 2014.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
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

ASSESSMENT PATTERN – THEORY

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 /Case Study 1/ Seminar 1 / Project1		50	50				100
Individual Assessment 2 /Case Study 2/ Seminar 2 / Project 2		50	50				100
ESE	10	40	50				100

22I0E$15	**VIDEO CREATION AND EDITING** *(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,The Filmmaker's Handbook: A Comprehensive Guide for the Digital Age,Fifth edition Penguin Publishing Group, 2012*

REFERENCES :

1	*Walter Murch,**In the Blink of an Eye: A Perspective on Film Editing"**, Silman-James Press,2001*
2	*Karel Reisz and Gavin Millar,**The Technique of Film Editing"**,second edition ,Taylor and Francis Group 2017*
3	*Ken Dancyger, **The technique of film and video editing** , fifth edition , Elsevier 2011.*
4	*Chris Kenworthy,Digital video production cookbook, OReillyMedia ,2006*
5	*Mark Brindle, The Digital Filmmaking Handbook ,Quercus Publishing, 2014*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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

Course Articulation Matrix														
COs/ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
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
22IOE$15	1	2	2	2	2	1	1	1	2	1	1	-	1	1
1– Slight, 2 – Moderate, 3 – Substantial														

b) CO and Key Performance Indicators Mapping	
CO	Key Performance Indicators
CO1	1.1.1,1.2.1,1.31,2.1.1,2.1.2,2.2.4,2.4.1,3.1.4,3.4.1,4.1.3,
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,,5.1.1,5.1.2,5.2.1,5.2.2,5.3.2,7.1.1,9.1.1,9.1.2,9.2.1,9.2.2,9.2.3,10.1.1,11.2.1,11.3.1,1 1.3.2
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, 7.12, 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

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
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

22IOE$16	DIGITAL MARKETING *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	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.	
UNIT – I	**INTRODUCTION TO DIGITAL MARKETING**	**9 Periods**
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.		
UNIT – II	**DIGITAL MARKETING STRATEGY DEVELOPMENT**	**9 Periods**
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		
UNIT – III	**DIGITAL MARKETING IMPLEMENTATION AND PRACTICE**	**9 Periods**
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		
UNIT – IV	**MARKETING COMMUNICATIONS USING DIGITAL MEDIA CHANNELS**	**9 Periods**
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		
UNIT – V	**EVALUATION OF DIGITAL CHANNEL PERFORMANCE**	**9 Periods**
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		
Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK :

1	*Dave Chaffey Fiona Ellis-Chadwick, Digital Marketing,sixth edition, 2016*

REFERENCES :

1	*Puneet singh Bhatia, Fundamentals of Digital Marketing , Pearson India Education services,2017*
2	*Mathur, Vibha, Arora, Saloni,"DigitalMarketing",PHI Learning Pvt. Ltd.,2020*
3	*Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Compaigns, Wiley 2016*
4	*Dr.Shakti Kundu, Digital Marketing Trends and Prospects:Develop an effective Digital Marketing strategy with SEO, SEM, PPC, Digital Display Ads & Email Marketing techniques,BPB PUBN,2021*
5	*Seema Gupta , Digital Marketing,Third Edition, McGraw Hill 2022*
6.	*Simon Kingsnorth, Digital Marketing Strategy:An Integrated Approach to Online Marketing, Kogan page,2022*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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

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	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
22IOE$16	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

22BOE$17	PRINCIPLES OF FOOD TECHNOLOGY *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	OE	3	0	0	3

Course Objective	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.	
UNIT – I	**FOOD AND ENERGY**	**9 Periods**
Constituents of food – carbohydrates, lipids, proteins, water, vitamins and minerals, dietary sources, role and functional properties in food, contribution to organoleptic and textural characteristics.		
UNIT – II	**FOOD BORNE DISEASES**	**9 Periods**
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.		
UNIT – III	**FOOD ADDITIVES**	**9 Periods**
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.		
UNIT – IV	**FOOD PRESERVATION**	**9 Periods**
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.		
UNIT – V	**FOOD PACKAGING**	**9 Periods**
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.		
Contact Periods: **Lecture: 45 Periods** **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**		

TEXT BOOK

1	*T.P. Coultate ,* ***Food – The Chemistry Of Its Components****, 6th Edn. Royal Society,London, 2015.*
2	*W.C. Frazier And D.C. Westhoff ,* ***Food Microbiology****, 4th Ed., Mcgraw-Hill Book Co., NewYork 2013.*

REFERENCES

1	*Srinivasan Damodaran and Kirk L. Parkin., "Fennema's Food Chemistry", CRC Press, 5 thedition. 2017.*
2	*Fellows P.J, "Food Processing Technology: Principles and Practices", Woodhead Publishing 4 th edition,2016.*
3	*B. Sivasanker , Food Processing And Preservation, Prentice-Hall Of India Pvt. Ltd. New Delhi 2002.*

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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
22BOE$17	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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

22BOE$18	**BIOLOGY FOR ENGINEERS** *(Common to All Branches)*

PREREQUISITES	CATEGORY	L	T	P	C
NIL	**OE**	**3**	**0**	**0**	**3**

Course Objectives	Understand and interpret commonly reported statistical measures published in healthcare research Analyze the different type of data using appropriate statistical software Demonstrate a good understanding of descriptive statistics and graphical tools Explain fundamental concepts of estimation and hypothesis testing and be confident when interpreting P values and confidence intervals	
UNIT – I	**BASICS OF CELL BIOLOGY**	**9 periods**
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.		
UNIT – II	**BASICS OF MICROBIOLOGY**	**9 periods**
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.		
UNIT – III	**HUMAN ANATOMY AND PHYSIOLOGY**	**9 periods**
Basics of human anatomy-tissues of the human body-epithelial-connective-nervous and muscular; Nervous system-Respiratory System-Circulatory system and Digestive system.		
UNIT – IV	**BIO MOLECULES AND IMMUNE SYSTEM**	**9 periods**
Introduction to Biochemistry-classification-structure and properties of carbohydrates- proteins- lipids and nucleic acids; Innate and acquired immunity; Types of immune responses.		
UNIT-V	**APPLIED BIOLOGY FOR ENGINEERS**	**9 periods**
Overview of biosensors - glucometer applications-medicine; Microarray analysis to diagnose the cancer; Microbial production of biofuels; Applications of stem cells.		
Contact Periods: **45** **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods**		

TEXT BOOK

1	*Darnell J, Lodish H, Baltimore D.* ***"Molecular Cell Biology"****, W.H.Freeman; 8th Edition, 2016.*
2	*Pelczar MJ, Chan ECS and Krein NR,* ***"Microbiology",*** *Tata McGraw Hill, 5thEdition, New Delhi.2001.*
3	*Wulf Cruger and Anneliese Cruger,* ***"A Textbook of Industrial Microbiology",*** *Panima Publishing Corporation, 2nd Edition, 2000.*

REFERENCES

1	*David L. Nelson and Michael M Cox,* ***"Lehninger's Principles of Biochemistry",*** *Macmillan Worth Publisher, 4th edition, 2004.*
2	*Brain R.Eggins ,* ***"Chemical Sensors and Biosensors",*** *John Wiley & Sons, 2002.*
3	*Anton Moser,* ***"Bioprocess Technology, Kinetics and Reactors",*** *Springer, Berlin (Verlag),1st edition, 1998*
4	*Kuby J,* ***"Immunology",*** *WH Freeman & Co., 7th edition, 2013.*

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE OUTCOMES: Upon completion of the course, the students will be able to:		**Bloom's Taxonomy Mapped**
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

a) Course Articulation Matrix

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
22BOE$18	1	1	-	1	2	2	2	2	3	3	2	2	2	3

1 – Slight, 2 – Moderate, 3 – Substantial

b) CO and Key Performance Indicators Mapping

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

ASSESSMENT PATTERN – THEORY

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

22NVA$05	CIRCUIT DESIGN AND SIMULATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

COURSE OBJECTIVE	To impart knowledge on electronic circuits design and implementation using PSpice software.	
UNIT - I	**CIRCUIT ANALYSIS USING PSPICE**	**5 Periods**
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		
UNIT - II	**SEMICONDUCTOR DEVICES AND OPAMP CHARACTERISTICS USING PSPICE**	**5 Periods**
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.		
UNIT - III	**SERIES AND PARALLEL-TUNED CIRCUITS USING PSPICE**	**5 Periods**
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.		
Contact Periods: 15 Periods **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOKS:

1	*P Tobin ,"**PSpice for Circuit Theory and Electronic Devices**", A Publication in the Morgan & Claypool Publishers series,2007.*
2	*Muhammad H. Rashid,"**SPICE forPower Electronics And Electric Power**"CRC Pres Taylor & Francis Group, 3rd edition ,2012.*

REFERENCES:

1	*Dennis Fitzpatrick ,"**Analog Design and Simulation using OrCAD Capture and PSpice**", Mara Conner,2nd Edition, 2017.*
2	*Hayt and Kimmerly, ,"**Electrical Circuit Analysis, by Mc Graw Hill**" 5th edition, 2017.*
3	*Rashid,"**Introduction to PSpice Using OrCAD for Circuits and Electronics**", 3rd edition, pearson, 2015*
4	*E.Ramshow, D.C. Schurman, "**PSpice Simulation of Power Electronics Circuits: An Introductory Guide**",Springer US, 1996.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

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	2	-	-	-	-	-	-	1	3	-	1
CO2	3	2	1	3	2	-	-	-	-	-	-	1	3	-	1
CO3	3	2	1	3	2	-	-	-	-	-	-	1	3	-	1
22NVA$05	2	2	1	2	2	-	-	-	-	-	-	1	3	-	1

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, 2.1.1, 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.

22NVA$06	PCB DESIGN AND FABRICATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

COURSE OBJECTIVE	To impart knowledge on steps involved in PCB design and fabrication process	
UNIT - I	**BASICS OF PRINTED CIRCUIT BOARDS**	**5 Periods**
PCB : Evolution, Components, Classification, Manufacturing - Challenges in modern PCB design and manufacture - PCBs with embedded components - Standards on PCBs		
UNIT - II	**LAYOUT PLANNING AND DESIGN**	**5 Periods**
Reading drawings and diagrams - Mechanical design considerations - Electrical design considerations -, Component placement rules - Fabrication and assembly consideration - Cooling requirements - Packaging density - Layout design - Documentation		
UNIT - III	**SOLDERING AND ASSEMBLY**	**5 Periods**
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		
Contact Periods: 15 Periods **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOKS:

1	*R.S.Khandpur,* ***" Printed Circuit Boards: Design, Fabrication, Assembly and Testing",*** *McGraw-Hill, 1st Edition,2005.*
2	*Jan Axelson,* ***" Making Printed Circuit Boards",*** *McGraw-Hill, 1st Edition, 1993.*

REFERENCES:

1	*Elaine Rhodes,* ***"Developing Printed Circuit Assemblies: From Specifications to Mass Production",*** *Lulu.com, 1st Edition, 2008*
2	*C. Robertson.* ***"PCB Designer's Reference",*** *Prentice Hall, 6th Edition, 2007*
3	*D. Brooks,* ***"Signal Integrity Issues and Printed Circuit Board Design",*** *Prentice Hall, 1st Edition, 2003*
4	*Jon Varteresian,* ***"Fabricating Printed Circuit Boards",*** *Newnes, 1st Edition, 2002*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

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	-	-
22NVA$06	2	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

22NVA$07	GRAPHIC COMMUNICATION

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

COURSE OBJECTIVE	To provide the foundation of problem solving software in the instrumentation field.	
UNIT - I	**FEATURES OF MATLAB**	**5 Periods**
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		
UNIT - II	**SOFTWARE TOOLS FOR SENSOR DESIGN**	**5 Periods**
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.		
UNIT - III	**SOLID WORKS**	**5 Periods**
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.		
Contact Periods: 15 Periods **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOKS:

1	*Gilat Amos, "**MATLAB: An Introduction with Applications**", John Wiley & Sons, Inc (Wiley Student Edition), 2008*
2	*Willis J., Dogra S, "**SolidWorks 2019: A Power Guide for Beginners and Intermediate User Paperback**", CADArtifex, 2019*

REFERENCES:

1	*Roger W. Pryor, "**Multiphysics Modeling Using COMSOL®: A First Principles Approach**", Jonesand Bartlett Publishers, 1st Edition, 2011.*
2	*Brian Hahn and Daniel Valentine, "**Essential MATLAB for Engineers and Scientists**", Elsevier, 6th edition, 2016.*
3	*Holly Moore, "**MATLAB for Engineers**", Pearson Education, 5th Edition, 2017.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING

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	-	-	2	-	-	-	-	-	-	-	-	2	-
CO2	2	1	-	-	2	-	-	-	-	-	-	-	-	2	-
CO3	2	1	-	-	2	-	-	-	-	-	-	-	-	2	-
22NVA$07	2	1	-	-	2	-	-	-	-	-	-	-	-	2	-

b) CO and Key Performance Indicators mapping

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

22NVA$08	INTEGRATED DEVELOPMENT ENVIRONMENT

PREREQUISITES	CATEGORY	L	T	P	C
NIL	EEC	1	0	0	1

COURSE OBJECTIVE	To provide the essential skills for app development using Integrated Development Environments (IDEs)	
UNIT - I	**INTRODUCTION**	**5 Periods**
IDEs – Brief history – Introduction to programming languages – general purpose IDEs – Language specific IDEs – Common Programming languages – C, Python and Java		
UNIT - II	**VISUAL STUDIO CODE BASICS**	**5 Periods**
Introduction – Installation - basic interface - create new files - understanding workspaces - Editor groups - Extension and Customization: Introduction - customizing themes - popular extensions. Shortcut and settings.		
UNIT - III	**ADVANCED CONCEPTS IN VISUAL STUDIO CODE**	**5 Periods**
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		
Contact Periods: 15 Periods **Lecture: 15 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 15 Periods**		

TEXT BOOKS:

1	*Sufyan Bin Uzayr, "**Mastering Visual Studio Code: A Beginner's Guide**", CRC press, 1st Edition, 2022*
2	*Alessandro Del Sole, "**Visual Studio Code Distilled**", Apress, 3rd Edition, 2023*
3	*Coursera course on "**Working with Integrated development Environments**"*

REFERENCES:

1	*Bruce Johnson, "**Visual Studio Code**", Wiley, 1st Edition, 2019.*
2	*April Speight, "**Visual Studio Code for Python programmers**",Wiley, 1st Edition, 2021.*
3	*Swapnil saurav, "**Python Apps on Visual Studio Code**", BPB Publications, 1st Edition, 2024.*
4	*Ovasis Mehboob, Ahmed Khan, "**Developing Multi-Platform Apps with Visual Studio Code**", Packt Publishing, 1st Edition, 2020.*

COURSE OUTCOMES Upon Completion of the course, the students will be able to		**Bloom's Taxonomy Mapped**
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

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	-	2	-	-	-	-	-	-	-	-	-	-
CO2	1	1	1	-	2	-	-	-	-	-	-	-	-	-	-
CO3	1	1	1	-	2	-	-	-	-	-	-	-	-	-	-
22NVA$08	1	1	1	-	2	-	-	-	-	-	-	-	-	-	-

b) CO and Key Performance Indicators mapping	
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