



# **GOVERNMENT COLLEGE OF TECHNOLOGY**

(An Autonomous Institution Affiliated to Anna University)

Coimbatore - 641 013

## **Curriculum and Syllabi For B.E. (ELECTRONICS AND INSTRUMENTATION ENGINEERING) (Full Time)**



**OFFICE OF THE CONTROLLER OF EXAMINATIONS  
GOVERNMENT COLLEGE OF TECHNOLOGY  
THADAGAM ROAD, COIMBATORE - 641 013**

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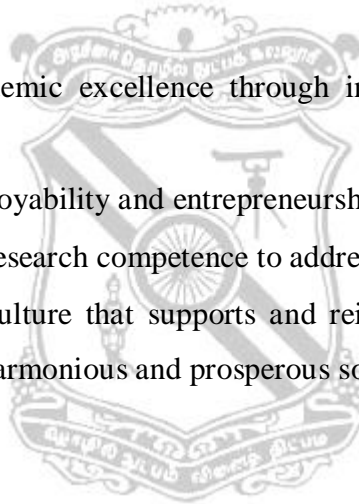
## VISION AND MISSION OF THE INSTITUTION

### VISION

- To emerge as a center of excellence and eminence by imparting technical education, 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 issues.
- To inculcate a culture that supports and reinforces ethical and professional behaviors for a harmonious and prosperous society.



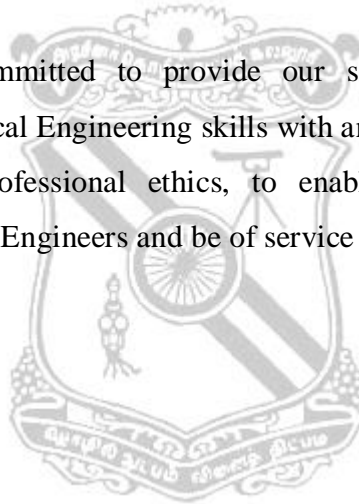
## **VISION AND MISSION OF THE DEPARTMENT**

### **VISION**

To be a premier value based department, committed to excellence in preparing students for success in Electronics and Instrumentation Engineering and Technology professions through research and Experience Based Instruction with the help of highly qualified and fully supportive faculty.

### **MISSION**

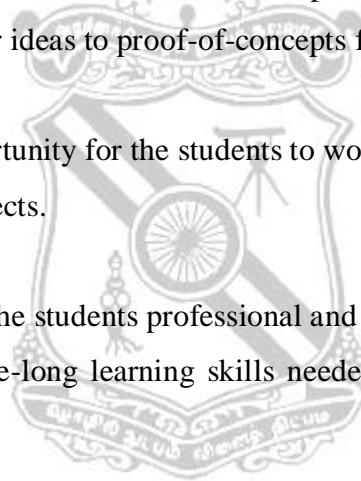
The department is committed to provide our students with strong theoretical foundations blended with practical Engineering skills with an emphasis on team work, critical and creative thinking and professional ethics, to enable them to become successful Electronics and Instrumentation Engineers and be of service to the society at large.



## **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

The following Programme Educational Objectives are designed based on the department mission.

- PEO 1 :** To provide students with the strong foundation in Mathematical, Scientific and Engineering fundamentals necessary to formulate, solve and analyse Engineering Problems related to Industry and Research.
- PEO 2 :** To impart the state of the art technology to the students in the field of Electronics and Instrumentation Engineering.
- PEO 3 :** To foster innovation, invention and entrepreneurship by enabling the students to transform their ideas to proof-of-concepts for High-Tech Applications.
- PEO 4 :** To provide opportunity for the students to work as part of teams on multi-disciplinary projects.
- PEO 5 :** To inculcate in the students professional and ethical attitude, communication skills and the life-long learning skills needed for the successful professional career.



## 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.

## PROGRAMME SPECIFIC OBJECTIVES (PSOs)

- PSO1:** To integrate fundamentals and recent approaches from engineering sciences and practice to accomplish professional development in a responsive and innovative manner.
- PSO2:** To apply appropriate techniques and modern Engineering hardware and software tools to design, implement & evaluate the process, instrumentation system measurement, and control to work effectively as an individual and in a multidisciplinary team.
- PSO3:** To continually be responsive to new technological and cultural challenges through life-long learning leading to advanced degrees, publications, presentations, awards and exhibit good citizenship with elegant mannerism.



**BOARD OF STUDIES IN BASIC SCIENCES 2016-17**  
**B.E.ELECTRONICS AND INSTRUMENTATION ENGINEERING**  
**CBCS 2016 REGULATIONS**

**FIRST SEMESTER**

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		<b>THEORY</b>								
1	16NHS1Z1	Communication Skills in English	HS	50	50	100	2	2	0	3
2	16NBS1Z2	Engineering Mathematics I	BS	50	50	100	3	2	0	4
3	16NBS103	Engineering Physics	BS	50	50	100	3	0	0	3
4	16NBS104	Applied Chemistry	BS	50	50	100	3	0	0	3
5	16NES105	Basics of Civil and Mechanical Engineering	ES	50	50	100	3	0	0	3
		<b>PRACTICAL</b>								
6	16NBS106	Chemistry Lab	BS	50	50	100	0	0	4	2
7	16NES107	Workshop Practice	ES	50	50	100	0	0	4	2
		<b>TOTAL</b>		<b>350</b>	<b>350</b>	<b>700</b>				<b>20</b>

**SECOND SEMESTER**

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		<b>THEORY</b>								
1	16NHS2Z1	Technical English	HS	50	50	100	2	2	0	3
2	16NBS2Z2	Engineering Mathematics II	BS	50	50	100	3	2	0	4
3	16NBS2Z3	Materials Science	BS	50	50	100	3	0	0	3
4	16NHS2Z4	Environmental Science and Engineering	HS	50	50	100	3	0	0	3
5	16NES2Z5	Programming in C	ES	50	50	100	3	0	0	3
6	16NES206	Engineering Mechanics	ES	50	50	100	3	2	0	4
		<b>PRACTICAL</b>								
7	16NBS207	Physics Laboratory	BS	50	50	100	0	0	4	2
8	16NES208	Engineering Graphics	ES	50	50	100	2	0	4	4
9	16NES2Z9	Programming in C Laboratory	ES	50	50	100	0	0	4	2
		<b>TOTAL</b>		<b>450</b>	<b>450</b>	<b>900</b>				<b>28</b>

### THIRD SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		<b>THEORY</b>								
1	16NBS3Z1	Engineering Mathematics III	BS	50	50	100	3	2	0	4
2	16NES302	Thermal Engineering and Fluid mechanics	ES	50	50	100	4	0	0	4
3	16NES303	Circuits and Networks	ES	50	50	100	2	2	0	3
4	16NPC304	Digital Principles and Applications	PC	50	50	100	3	0	0	3
5	16NPC305	Sensors and Transducers	PC	50	50	100	3	0	0	3
6	16NPC306	Electronic Devices and Circuits	PC	50	50	100	4	0	0	4
		<b>PRACTICAL</b>								
7	16NES307	Thermal Engineering and Fluid mechanics Laboratory	ES	50	50	100	0	0	4	2
8	16NPC308	Electric Circuits and Electronic Devices Laboratory	PC	50	50	100	0	0	4	2
		<b>TOTAL</b>		<b>400</b>	<b>400</b>	<b>800</b>	<b>19</b>	<b>4</b>	<b>8</b>	<b>25</b>

### FOURTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		<b>THEORY</b>								
1	16NBS401	Probability, Random Processes and Queueing Theory	BS	50	50	100	3	2	0	4
2	16NPC402	Linear integrated circuits	PC	50	50	100	3	0	0	3
3	16NPC403	Signals and Linear Systems	PC	50	50	100	3	2	0	4
4	16NPC404	Electrical and Electronic Measurements and Instrumentation	PC	50	50	100	3	0	0	3
5	16NES405	Electrical Drives	ES	50	50	100	3	0	0	3
		<b>PRACTICAL</b>								
6	16NES406	Electrical Machines and Drives Laboratory	ES	50	50	100	0	0	4	2
7	16NPC407	Linear and Digital Circuits Laboratory	PC	50	50	100	0	0	4	2
8	16NPC408	Sensors and Measurements Laboratory	PC	50	50	100	0	0	4	2
		<b>TOTAL</b>		<b>400</b>	<b>400</b>	<b>800</b>	<b>15</b>	<b>4</b>	<b>12</b>	<b>23</b>



### FIFTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		<b>THEORY</b>								
1	16NPC501	Control systems	PC	50	50	100	2	2	0	3
2	16NPC502	Principles of Communication Systems	PC	50	50	100	3	0	0	3
3	16NPC503	Industrial instrumentation I	PC	50	50	100	3	0	0	3
4	16NPC504	Microprocessor and Microcontroller Based System	PC	50	50	100	3	2	0	4
5	16NPC505	Industrial Hydraulics and Pneumatics	PC	50	50	100	3	0	0	3
6	E-1	Open Elective I	OE	50	50	100	3	0	0	3
		<b>PRACTICAL</b>								
7	16NPC507	Control Systems Laboratory	PC	50	50	100	0	0	4	2
8	16NPC508	Microprocessors and Microcontrollers Laboratory	PC	50	50	100	0	0	4	2
		<b>TOTAL</b>		<b>400</b>	<b>400</b>	<b>800</b>	<b>18</b>	<b>2</b>	<b>8</b>	<b>23</b>

### SIXTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		<b>THEORY</b>								
1	16NPC601	Industrial instrumentation II	PC	50	50	100	3	0	0	3
2	16NPC602	Process control	PC	50	50	100	3	0	0	3
3	16NPC603	Discrete Time Signal Processing	PC	50	50	100	3	2	0	4
4	16NPC604	Analytical Instrumentation	PC	50	50	100	3	0	0	3
5	E – II	Open Elective II	OE	50	50	100	3	0	0	3
6	E –III	Professional Elective I	PE	50	50	100	3	0	0	3
		<b>PRACTICAL</b>								
7	16NPC607	Process control Lab	PC	50	50	100	0	0	4	2
8	16NPC608	Industrial Instrumentation Lab	PC	50	50	100	0	0	4	2
9	16NEE609	Mini project / Industrial Training/ Internship	EEC	100	0	100	0	0	4	2
		<b>TOTAL</b>		<b>500</b>	<b>400</b>	<b>900</b>	<b>18</b>	<b>2</b>	<b>12</b>	<b>25</b>

### SEVENTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		<b>THEORY</b>								
1	16NHS701	Industrial Management and Economics	HS	50	50	100	3	0	0	3
2	16NPC702	Distributed Control System and Applications	PC	50	50	100	3	0	0	3
3	E – IV	Open Elective III	OE	50	50	100	3	0	0	3
4	E – V	Professional Elective II	PE	50	50	100	3	0	0	3
5	E – VI	Professional Elective III	PE	50	50	100	3	0	0	3
6	E – VII	Professional Elective IV	PE	50	50	100	3	0	0	3
		<b>PRACTICAL</b>								
7	16NEE707	Instrumentation System Design Lab	EEC	50	50	100	0	0	4	2
8	16NEE708	Industrial automation Lab	EEC	50	50	100	0	0	4	2
		<b>TOTAL</b>		<b>400</b>	<b>400</b>	<b>800</b>	<b>19</b>	<b>0</b>	<b>8</b>	<b>22</b>

### EIGHTH SEMESTER

Sl. No.	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
		<b>THEORY</b>								
1	E – VIII	Professional Elective V	PE	50	50	100	3	0	0	3
2	E – IX	Professional Elective VI	PE	50	50	100	3	0	0	3
3	16NEE801	Project Work	EEC	50	50	100	0	0	16	8
		<b>TOTAL</b>		<b>150</b>	<b>150</b>	<b>300</b>	<b>6</b>	<b>0</b>	<b>16</b>	<b>14</b>

**PROFESSIONAL ELECTIVES (PE)**

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1	16NPEX01	Modern Control Theory	PE	50	50	100	3	0	0	3
2	16NPEX02	Digital Control System	PE	50	50	100	3	0	0	3
3	16NPEX03	Foundation of Machine Learning Systems	PE	50	50	100	3	0	0	3
4	16NPEX04	Advanced Process Control	PE	50	50	100	3	0	0	3
5	16NPEX05	BioMedical Instrumentation	PE	50	50	100	3	0	0	3
6	16NPEX06	Instrumentation Standards	PE	50	50	100	3	0	0	3
7	16NPEX07	Fiber Optics and Laser Instrumentation	PE	50	50	100	3	0	0	3
8	16NPEX08	MEMS and Nano Technology	PE	50	50	100	3	0	0	3
9	16NPEX09	Aircraft Instrumentation	PE	50	50	100	3	0	0	3
10	16NPEX10	Robotics and Its Applications	PE	50	50	100	3	0	0	3
11	16NPEX11	Real Time Embedded Systems	PE	50	50	100	3	0	0	3
12	16NPEX12	Automotive Electronics For Electrical Engineering	PE	50	50	100	3	0	0	3
13	16NPEX13	Fundamentals of Digital Image Processing	PE	50	50	100	3	0	0	3
14	16NPEX14	Smart and Wireless Instrumentation	PE	50	50	100	3	0	0	3
15	16NPEX15	Power Plant Instrumentation	PE	50	50	100	3	0	0	3
16	16NPEX16	Instrumentation and Control In Petro Chemical Industry	PE	50	50	100	3	0	0	3
17	16NPEX17	Industrial Internet of Things (IIoT)	PE	50	50	100	3	0	0	3
18	16NPEX18	Safety Instrumented Systems	PE	50	50	100	3	0	0	3
19	16NPEX19	Unit Operations of Process	PE	50	50	100	3	0	0	3
20	16NPEX20	Energy Harvesting	PE	50	50	100	3	0	0	3

## OPEN ELECTIVES

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
1	16AOEX01	NanoScience and Technology	OE	50	50	100	3	0	0	3
2	16AOEX02	Material Characterizations	OE	50	50	100	3	0	0	3
3	16AOEX03	Electrochemical Technology	OE	50	50	100	3	0	0	3
4	16AOEX04	Polymer Technology	OE	50	50	100	3	0	0	3
5	16COEX05	Disaster Management and Mitigation	OE	50	50	100	3	0	0	3
6	16COEX06	Environmental Management	OE	50	50	100	3	0	0	3
7	16COEX07	Town Planning and Architecture	OE	50	50	100	3	0	0	3
8	16MOEX08	Total Quality Management for Engineers	OE	50	50	100	3	0	0	3
9	16MOEX09	Composite materials	OE	50	50	100	3	0	0	3
10	16MOEX10	Automobile Engineering	OE	50	50	100	3	0	0	3
11	16EOEX11	Renewable Energy Sources and Technology	OE	50	50	100	3	0	0	3
12	16EOEX12	Smart Grid Technology	OE	50	50	100	3	0	0	3
13	16LOEX13	Principles of Communication	OE	50	50	100	3	0	0	3
14	16LOEX14	Microcontrollers and its applications	OE	50	50	100	3	0	0	3
15	16NOEX15	Industrial Automation Systems	OE	50	50	100	3	0	0	3
16	16NOEX16	Measurement and Instrumentation	OE	50	50	100	3	0	0	3
17	16SOEX17	Enterprise JAVA	OE	50	50	100	3	0	0	3
18	16SOEX18	Cyber Security	OE	50	50	100	3	0	0	3
19	16SOEX19	Network Essential	OE	50	50	100	3	0	0	3
20	16IOEX20	Programming in Python	OE	50	50	100	3	0	0	3
21	16IOEX21	BIG Data Science	OE	50	50	100	3	0	0	3
22	16IOEX22	Object Oriented Programming using C++	OE	50	50	100	3	0	0	3
23	16BOEX23	Computational Biology	OE	50	50	100	3	0	0	3
24	16BOEX24	Biology for Engineers	OE	50	50	100	3	0	0	3
25	16BOEX25	Fundamentals of Bio Engineering	OE	50	50	100	3	0	0	3

### ONE CREDIT COURSES

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem Marks	Total Marks	Credits			
							L	T	P	C
<b>ONE CREDIT COURSES</b>										
1	16NOC1Z1	Human Values -I	OC	-	-	-	1	0	0	1
2	16NOCX02	Human Values and Professional Ethics	OC	-	-	-	1	0	0	1
3	16NOCX03	MATLAB Programming	OC	-	-	-	1	0	0	1
4	16NOCX04	Calibration of instruments	OC	-	-	-	1	0	0	1
5	16NOCX05	LabVIEW Programming	OC	-	-	-	1	0	0	1
6	16NOCX06	Graphical System Design	OC	-	-	-	1	0	0	1
7	16NOCX07	PCB Design and Fabrication	OC	-	-	-	1	0	0	1
8	16NOCX08	Electrical Writing, Winding and Earthing Repaireing Household Applications	OC	-	-	-	1	0	0	1
9	16NOCX09	Non Destructive Testing Techniques	OC	-	-	-	1	0	0	1
10	16NOCX10	Electrical Safety	OC	-	-	-	1	0	0	1

### SUMMARY OF CREDIT DISTRIBUTION

B.E- Electronics and Instrumentation Engineering																
S. No	Course work subject area	Credits per Semester								Total Credits	% of Total Credits	Total subjects	Credit range (AICTE Recommendation)		In no of subjects assuming 3 credit subject	
		I	II	III	IV	V	VI	VII	VIII				Min	Max		
1	HS	3	6					3		12	6	4	5	10	3	6
2	BS	12	9	4	4					29	16	9	15	20	9	12
3	ES	5	13	9	5					32	18	11	15	20	9	12
4	PC			12	14	20	17	3		66	37	23	30	40	18	24
5	PE						3	9	6	18	10	6	10	15	6	9
6	OE					3	3	3		9	5	3	5	10	3	6
7	EEC						2	4	8	14	9	4	10	15		
<b>TOTAL</b>		<b>20</b>	<b>28</b>	<b>25</b>	<b>23</b>	<b>23</b>	<b>25</b>	<b>22</b>	<b>14</b>	<b>180</b>		<b>60</b>				

HS	Humanities and Social Science
BS	Basic Science
ES	Engineering Science
PC	Professional Core
PE	Professional Elective
OE	Open Elective
EEC	Employment Enhancement Course

16NHS1Z1

**COMMUNICATION SKILLS IN ENGLISH**  
(Common to all branches)

**Category : HS**  
L T P C  
2 2 0 3

**Pre-Requisites: Nil**

**Course Objectives:**

- To make the learners understand the usage of basic grammar in English.
- To enhance the learner's speaking skills through appropriate listening practice.
- To instill reading habits to practice communicative tasks and comprehension
- To improve the learner's writing skills through various means
- To enrich the vocabulary of learners for speaking and writing

**UNIT I**

**6+6 Periods**

**Listening** - Listening to practice basic pronunciation at phonemic and word level, Listening to informal conversations of exchanging greetings and introducing oneself/others; **Speaking**-Introducing oneself, one's family / friend, speaking about one's place; **Reading**-Reading to practice stress and pause; **Writing**-Autobiographical writing, Letter to seek permission, Letter to issue certificates; **Grammar**- Use of Auxiliary Verbs, Adjectives and Adverbs; **Vocabulary**-Word formation, Synonyms and Antonyms of High frequency words.

**UNIT II**

**6+6 Periods**

**Listening**-Listening to Telephone Conversations for taking and leaving messages, making enquiries; **Speaking**—Role-play activities based on real life situations, Narrating daily routines; **Reading**– skimming and scanning, Reading for comprehension with exercises; **Writing**-Advertisements and slogan writing, Imperative instructions, Definitions; **Grammar** – Tenses, Prepositions; **Vocabulary**- Commonly confused words

**UNIT III**

**6+6 Periods**

**Listening** -Listening to give instructions, Making requests and responding to requests, Thanking someone and responding to thanks; **Speaking** -Group Discussion on chosen topics, Describing a simple process; **Reading**-Reading and interpreting visual material, Critical reading; **Writing** –Letter to the Editor of a Newspaper, Recommendations; **Grammar**- Impersonal Passive, Subject-verb agreement; **Vocabulary**- Collocation, Word Association

**UNIT IV**

**6+6 Periods**

**Listening**-Listening to accept/refuse invitation, Listening to apologize, Listening to congratulate; **Speaking** – Debates on current social affairs; **Reading** –Reading to make inference, Paraphrasing; **Writing**- Personal letter (Inviting your friend to a function, congratulating someone on his / her success, thanking one's friends / relatives); **Grammar** – 'Wh'-questions, Modal verbs; **Vocabulary** -Single word substitutes -Use of abbreviations & acronyms

**UNIT V**

**6+6 Periods**

**Listening** -Video Listening to different accents, Viewing Speeches, Viewing English songs, Viewing short films; **Speaking** -Giving impromptu talks, Making presentations on given topics; **Reading** –Extensive reading; **Writing** –Writing General Article, Writing Short Stories; **Grammar** - Common Errors in English; **Vocabulary** –Word Pairs with Repetitive meaning.

**Contact Periods:**

**Lecture: 30 Periods**

**Tutorial: 30 Periods**

**Practical: 0 Periods**

**Total: 60 Periods**

**TEXT BOOKS****AUTHOR NAME****TITLE OF BOOK****PUBLISHER,  
YEAR OF PUBLICATION**

*Department of English, Anna  
University. Mindscapes  
Sadanand, Kamlesh & Punitha,  
Susheela*

*English for Technologists  
and Engineers  
Spoken English: A  
Foundation Course (Part 1)*

*Orient Blackswan, Chennai. 2012*

*Orient Blackswan, Hyderabad.  
2014*

**REFERENCE BOOKS****AUTHOR NAME****TITLE OF BOOK****PUBLISHER,  
YEAR OF PUBLICATION**

*Raman, Meenakshi &  
Sangeetha Sharma  
Vijay, Anbazhagan.J, &  
Jaishree.N*

*Technical Communication:  
Principles and Practice*

*Oxford University Press, New  
Delhi. 2011*

*Rizvi, Ashraf. M.*

*Effective Technical  
Communication*

*Tata McGraw-Hill, New Delhi.  
2005*

*Rutherford, Andrea. J Basic*

*Communication Skills for  
Technology*

*Pearson, New Delhi. 2001*

*Redston, Chris,  
Cunningham, Gillie*

*Face 2 Face: Elementary  
Student's Book*

*Cambridge University Press, New  
Delhi. 2009*

**EXTENSIVE READING**

(Not for Examination)

Kalam, Abdul. A.P.J. Wings of Fire. Universities Press, Hyderabad. 1999.

**Websites**

1. <http://www.usingenglish.com>
2. <http://www.uefap.com>

**COURSE OUTCOMES:**

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

**CO1:** The learner will be able to understand basic grammar and the learner will have sufficient command over language by training his tongue and tuning his ear through apt listening tasks.

**CO2:** Reading tasks will enable the learner practice phonological and linguistic aspect of learning, help comprehend and create interest in extensive reading.

**CO3:** The learner shall be able to write appropriately for a given context and use the right word at the right place.

**COURSE ARTICULATION MATRIX**

CO/PO	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
CO 1	-	-	M	-	M	-	-	-	-	-	-	-	L	-	-
CO 2	-	-	-	-	-	M	-	-	-	-	M	-	-	-	M
CO 3	-	-	-	-	-	-	-	-	-	H	-	-	-	-	-
16NHS1Z1	-	-	M	-	M	M	-	-	-	H	M	-	L	-	M

**L- Low, M – Moderate (Medium), H – High**



16NBS1Z2

**ENGINEERING MATHEMATICS I**  
( Common to all branches)

**Category : BS**

L T P C

3 2 0 4

**Pre-Requisites: Nil**

**Course Objectives:**

- To familiarize techniques of matrix algebra including properties of eigen values and eigen vectors.
- To gain the knowledge of hyperbolic functions and application problems in differential calculus.
- To familiarize with functions of several variables and Functions of two variables including extremum problems, Jacobian and Leibnitz rule of integration.
- To perform double and triple integration with relevant to surface area and volume of solid.

**UNIT I MATRICES**

**9+6 Periods**

Eigen values and Eigen vectors of a real matrix-Characteristic equation-Properties of Eigen values and eigen vectors-Cayley Hamilton theorem - Diagonalization of matrices-Reduction of a quadratic form to canonical form by orthogonal transformation-Nature of quadratic forms.

**UNIT II HYPERBOLIC FUNCTIONS AND DIFFERENTIAL CALCULUS**

**9+6 Periods**

Hyperbolic and Inverse Hyperbolic functions-Identities- Real and Imaginary parts-Solving Problems using Hyperbolic functions.

Curvature and radius of curvature-Cartesian and polar coordinates- center of curvature and Evolutes- Envelopes and Evolute as envelope of normal.

**UNIT III FUNCTIONS OF SEVERAL VARIABLES**

**9+6 Periods**

Functions of two variables- Taylor's theorem (statement only) and expansions-Maxima and Minima- Constrained extremum by Lagrange's multiplier method-Jacobians-Differentiation under integral sign

**UNIT IV INTEGRAL CALCULUS**

**9+6 Periods**

Definite and Indefinite integrals-Substitution rule-Techniques of Integration-Integration by parts-Trigonometric substitutions-Integration of rational function by partial fractions-Integration of irrational functions-Improper integrals.

**UNIT V MULTIPLE INTEGRALS**

**9+6 Periods**

Beta and Gamma integrals and properties. Double Integrals-Change of order of integration-Double integrals in polar coordinates-Area enclosed by plane curves-Triple integrals-Volume as a triple integral-Transformation to Polar, Cylindrical and Spherical polar coordinates.

**Contact Periods:**

**Lecture: 45 Periods    Tutorial: 30 Periods    Practical: 0 Periods    Total: 75 Periods**

**TEXT BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
Veerarajan T	Engineering Mathematics for Semesters I and II	Tata McGraw Hill Publishing Co., New Delhi, 2015.
Kandasamy P, Thilagavathy K and Gunavathy K	Engineering Mathematics for I year B.E/B.Tech.	S.Chand & Co, Ramnagar, New Delhi, Reprint 2013.
S. Narayanan and Manicavachagom Pillai T.K.	Calculus, Vol.I, II and III,	S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai, 2009.

**REFERENCE BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
Erwin Kreyszig	Advanced Engineering Mathematics	Wiley & sons (Asia) Ltd, 10th Edition, 2015.
Ray Wylie.C and Louis Barrett	Advanced Engineering Mathematics	Tata McGraw Hill Company, New Delhi, 2004.
Grewal B. S	Higher Engineering Mathematics	Khanna Publishers, New Delhi, 43rd Edition, 2014.
Ramana B V	Higher Engineering Mathematics	Tata McGraw Hill Co. Ltd, New Delhi, 11th Print, 2010.
Bali N., Goyal M and Watkins C	Advanced Engineering Mathematics	Firewall Media (An Imprint of Laxmi Publications Pvt Ltd), New Delhi, 7th Edition, 2009.
Bali N.P and Goyal M	A text book of Engineering Mathematics	University Science Press (An Imprint of Laxmi Publications Pvt Ltd), New Delhi, 2014

**COURSE OUTCOMES:**

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

- CO1:** Acquire knowledge of eigen values and eigen vectors including properties through matrix theory.
- CO2:** Understand the hyperbolic functions and applications of differential calculus.
- CO3:** Acquire fluency in partial differentiation and solving problems related to maxima and minima for more independent variables.
- CO4:** Understand the standard types of integration and solution to various integrals.
- CO5:** Understand the multiple integrals and their applications to engineering problems.

**COURSE ARTICULATION MATRIX**

<b>CO/PO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	H	H	H	M	-	-	-	-	-	H	M	M	M	H	M
<b>CO 2</b>	H	M	M	-	-	-	-	-	-	M	-	-	M	H	L
<b>CO 3</b>	H	H	H	-	-	-	-	-	-	L	-	-	M	H	-
<b>CO 4</b>	H	H	M	M	-	-	-	-	-	M	L	M	L	M	L
<b>CO 5</b>	H	M	M	-	-	-	-	-	-	L	L	M	L	M	L
<b>16NBS1Z2</b>	H	H	M	M	-	-	-	-	-	M	L	M	M	H	L

**L- Low, M – Moderate (Medium), H – High**

**16NBS103**

**ENGINEERING PHYSICS**  
(Common to EEE, ECE, EIE, CSE & IT branches)

**Category : BS**  
L T P C  
3 0 0 3

**Pre-Requisites: Nil**

**Course Objectives:**

To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology. Upon completion of this course the students will be familiar with:

- Concepts, types of lasers and its applications, fibre optic principles and its applications.
- Basics of properties of matter & thermal physics
- Origin of quantum physics, Schrödinger's equation and applications.
- Principles of acoustics, ultrasonics and their industrial applications.
- Fundamentals of crystal Physics and its packing factor calculations.

**UNIT I LASERS & FIBRE 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 Nd-YAG, CO<sub>2</sub>, Semiconductor laser - applications of laser-Hologram

Introduction – Basic Principles involved in fiber optics- Total internal reflection – Structure of optical fiber –Propagation of light through optical fiber –Derivation for Numerical Aperture and acceptance angle - fractional index change - Classification of optical fiber based on materials, refractive index profile and Modes - Fiber optical communication links-Fiber optic sensors- displacement.

**UNIT II PROPERTIES OF MATTER & THERMAL PHYSICS 9 Periods**

Elasticity- Hooke's law- stress-strain diagram - Factors affecting elasticity - Bending moment - Depression of a cantilever - Young's modulus by uniform bending - I shaped girders. Thermal expansion - thermal stress - thermal conductivity - heat conduction in solids - flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment.

**UNIT III 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 IV ACOUSTICS & ULTRASONICS 9 Periods**

Classification of sound - loudness and intensity - Weber-Fechner law - standard intensity and intensity level - decibel - reverberation - reverberation time - sound absorbing materials - Determination of absorption coefficient - factors affecting acoustics of buildings.

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 ultrasonics-cavitation - applications- ultrasonic drilling- ultrasonic welding- ultrasonic soldering and ultrasonic cleaning-Non- destructive Testing- Pulse echo system.

**UNIT V CRYSTAL PHYSICS****9 Periods**

Introduction – Crystalline and amorphous materials –Lattice – Unit Cell –Crystal system - Bravais lattices – Miller indices – 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.

**Contact Periods:**

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

**TEXT BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>Arumugam M</i>	<i>Engineering Physics</i>	<i>Anuradha Publishers, 2010. (Unit I, Unit III &amp; Unit IV)</i>
<i>P.K.Palanisamy</i>	<i>Engineering Physics</i>	<i>Scitech Publications(India) Pvt. Ltd, 2015 (Unit II &amp; Unit V)</i>

**REFERENCE BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>Avadhanulu M N and Kshirsagar P G</i>	<i>A Textbook of Engineering Physics</i>	<i>S.Chand and Company Ltd, New Delhi, 2010.</i>
<i>Gaur R.K. and Gupta S.L</i>	<i>Engineering Physics</i>	<i>Dhanpat Rai Publishers, 2009.</i>
<i>K.Rajagopal</i>	<i>Engineering Physics</i>	<i>PHI Learning Private Ltd, New Delhi, 2015.</i>

**COURSE OUTCOMES:**

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

**CO1:** Analyze the construction and working of Nd-YAG, CO<sub>2</sub>, Semiconductor lasers. Explain fiber optics and classify fibers based on index profiles and modes. [Familiarity]

**CO2:** Acquire knowledge in properties of matter and thermal physics [Application]

**CO3:** Analyze the dual nature of matter using Heisenberg's Uncertainty principle, Schrodinger's time independent and dependent wave equations.[Assessment]

**CO4:** Apply piezoelectric detector method for industrial applications. [Usage and Assessment]

**CO5:** Compare crystalline and non-crystalline materials and describe the lattice structure, coordination number and packing factor for crystals.[Usage and Assessment]

**COURSE ARTICULATION MATRIX:**

<b>CO/PO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H
<b>CO 2</b>	H	H	H	H	H	H	H	-	-	-	-	-	H	M	H
<b>CO 3</b>	H	H	M	M	M	M	M	-	-	-	-	-	H	M	H
<b>CO 4</b>	H	H	M	M	M	M	M	-	-	-	-	-	H	H	H
<b>CO 5</b>	H	H	M	M	M	M	M	-	-	-	-	-	H	H	H
<b>16NBS103</b>	H	H	M	M	M	M	M	-	-	-	-	-	H	M	H

**L- Low, M – Moderate (Medium), H – High**

**16NBS104****APPLIED CHEMISTRY****Category : BS***(Common to EEE, ECE, EIE, CSE & IT branches)*L T P C  
3 0 0 3**Pre-Requisites: Nil****Course Objectives:**

- The course is aimed at inculcating knowledge of applied chemistry topics which would be useful for students to understand Chemistry relevant to circuitry Engineering subjects.

**UNIT I ELECTROCHEMICAL CELLS 9 Periods**

Galvanic cells – redox reactions- electrodes - metal and metal ion, hydrogen electrode and calomel electrode – electrode potentials – standard oxidation and reduction potentials - Nernst equation and problems - EMF series and significance – Application of EMF measurements – equilibrium constant, solubility of sparingly soluble salt, potentiometric titration of a redox system (  $Fe^{2+}$  Vs  $Cr^{6+}$ ), pH measurement using glass electrode and fluoride measurement by ISE.

**UNIT II BATTERIES 9 Periods**

Batteries - components, characteristics - voltage, current, current capacity, power density, energy density, cycle life, shelf life and self - discharge. Types of batteries - Primary - Zn/MnO<sub>2</sub> , Zn/HgO, Zn/Ag<sub>2</sub>O, Li/SOCl<sub>2</sub> - construction, function and performance comparison – Secondary- Pb/ acid, Ni/Cd, and Lithium ion battery - construction, function and performance comparison.

**UNIT III CORROSION 9 Periods**

Corrosion - Spontaneity - Chemical corrosion- mechanism, nature of oxides – Pilling Bedworth rule - electrochemical corrosion – mechanism - types – galvanic and differential aeration – Galvanic series and importance – Prevention methods - design of materials, cathodic protection techniques (sacrificial anode and impressed current cathode), Inhibitors - Protective coatings - Inorganic coating - electroplating – surface preparation and plating method applied to Cr and Ni and galvanising – Organic coating- paints - constituents and functions.

**UNIT IV POLYMER TECHNOLOGY 9 Periods**

Polymers - definitions of monomer, polymer, functionality, degree of polymerisation – Free radical mechanism -Individual polymers - PVC, PMMA, Teflon, polyamide, poly carbonate, epoxy, polyurethane - preparation, properties and their end users - compounding of plastics - components and functions - fabrication techniques - compression, injection, extrusion and blow moulding - Conducting polymers - structures of polypyrrole, polyaniline and poly acetylene - conduction mechanism of polyacetylene only - Biodegradable polymers – polylactide, starch and cellulose.

**UNIT V SILICON WAFER TECHNOLOGY 9 Periods**

Silicon for IC chips - single crystal – preparation by Czochralsky 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 - metal coatings.

**Contact Periods:****Lecture: 45 Periods    Tutorial: 0 Periods    Practical: 0 Periods    Total: 45 Periods****TEXT BOOKS****AUTHOR NAME****TITLE OF BOOK****PUBLISHER,  
YEAR OF PUBLICATION**

*Vairam S, Subha Ramesh  
Jain. P.C. and Monica  
Jain*

*Engineering Chemistry  
Engineering Chemistry*

*Wiley India, 2015.  
Dhanpat Rai Publications Pvt Ltd,  
New Delhi, 16<sup>th</sup> Edition, 2004.*

## REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Dara. S.S, Umarae	Text book of Engineering Chemistry	S. Chand Publications, 2004.
M.S.Tyagi	Introduction to semiconductor materials and devices	Wiley India, 2011.
Kuriakose, J.C., and Rajaram J	“Chemistry in Engineering and Technology”, Vol.1 &II	Tata Mc Graw Hill Publishing company, Pvt.Ltd, New Delhi, 2001.
P. Aggarwal, Avinash Aggarwal	Engineering Chemistry	Khanna Publishers, 2010.
David Linden and Thomas Reddy	Hand book of batteries and fuel cells”, Vol.1 &II	Tata Mc Graw Hill, 2001.

## COURSE OUTCOMES:

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

- CO1:** Understand the principles of electrochemical principles such as EMF measurements, electrode potentials and apply them in experimental techniques useful for electrochemical instrumentation.
- CO2:** Know the knowledge about different types of batteries with the functions which find use in their society including engineering fields.
- CO3:** Be familiar with corrosion of the instruments and equipment they use in their field and also to learn the mechanisms and the preventive measures by various techniques.
- CO4:** Know about the different types of polymeric materials, properties and fabrication which match the specific applications.
- CO5:** Gain the knowledge about the silicon chips and their fabrication methods and to apply in preparation of in electrical and electronic instruments.

## Course Articulation Matrix

CO/PO	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
CO 1	H	M	L	L	L	L	L	L	L	M	L	L	M	L	L
CO 2	H	L	M	L	M	L	L	L	L	M	L	L	M	M	L
CO 3	H	H	M	L	M	L	L	L	L	M	L	L	M	M	L
CO 4	H	L	H	L	L	M	M	L	L	M	L	L	M	M	L
CO 5	H	L	H	L	L	L	L	L	L	M	L	L	M	M	L
16NBS104	H	M	L	L	M	L	L	L	L	M	L	M	M	L	L

**L- Low, M – Moderate (Medium), H – High**

**16NES105 BASICS OF CIVIL AND MECHANICAL ENGINEERING**  
(Common to EEE, ECE, EIE branches)

**Category : ES**  
**L T P C**  
**3 0 0 3**

**Pre-Requisites: Nil**

**Course Objectives:**

- To learn the manufacturing process, types, applications and testing procedures for materials used for construction
- To impart knowledge about basis of recent paradigms, and new materials
- To make the students aware of the basic fields in Civil Engineering and about the construction.
- To impart knowledge to the students in the basics of mechanical sciences.
- To impart basic knowledge on manufacturing and machining processes.

**PART A : CIVIL ENGINEERING**

**50 Marks**

**UNIT I BUILDING MATERIALS AND CONSTRUCTION**

**8 Periods**

**Stone** - Properties and uses, **Bricks** - Properties and uses , **Cement** - composition, types and uses , Properties and uses of **Steel, Timber, Concrete** and its Properties.

**Masonry** - Brick masonry and Stone masonry.

**Flooring** - Various types of floor finishing for Residential, Industrial and Office buildings.

**Roofing** - RCC roof and Steel trusses.

**UNIT II WATER SUPPLY AND SANITARY ENGINEERING**

**8 Periods**

**Water Supply Engineering** – Objectives of water supply projects – necessity – sources of water – distribution of water.

**Sanitary Engineering** – Objectives of sanitary projects – systems of sewerage – natural methods of sewage disposal.

**UNIT III IRRIGATION ENGINEERING AND TRANSPORTATION ENGINEERING**

**8 Periods**

**Irrigation Engineering** – Needs of irrigation – purpose and functions of storage structures – Dams – parts of the dam and their functions.

**Transportation Engineering** - Roads – types- purposes - uses. Railways – gauges – components – usefulness.

**PART B : MECHANICAL ENGINEERING**

**50 Marks**

**UNIT IV ENERGY ENGINEERING**

**8 Periods**

Working principles of impulse and reaction turbines -working principles of IC engines (CI an SI engines) – power plants – steam power plant.

**UNIT V MANUFACTURING PROCESS**

**8 Periods**

Basic principles of moulding- melting of metals and casting-crucible furnace and cupola-Basic principles of hand forging-mechanical power hammers-hot and cold forging process –basics of extrusion process - Basic principle of welding – manual metal arc welding -gas welding and gas cutting-brazing and soldering.

**UNIT VI METAL CUTTING PROCESS**

**8 Periods**

Lathe: Main components and their functions- basic operations of turning, facing, taper turning, and thread cutting - introduction to CNC lathe - Drilling Machine: types of drilling machines -bench, upright - main parts and their functions-reaming operations

**Contact Periods:**

**Lecture: 48 Periods    Tutorial: 0 Periods    Practical: 0 Periods    Total: 48 Periods**

**TEXT BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>S.C. Rangawala</i>	<i>Engineering materials</i>	<i>Charotar Publishing House, New Delhi.2014.</i>
<i>S.K. Duggal</i>	<i>Building Materials</i>	<i>New Age International, 2012.</i>
<i>M.S.Palanichamy</i>	<i>“Basic Civil Engineering”, Third Edition</i>	<i>Tata McGraw Hill Company Limited, New Delhi, 2000.</i>
<i>Venugopal. K</i>	<i>Basic Mechanical Engineering</i>	<i>Anuradha Publications, 3<sup>rd</sup> Edition, 2010.</i>
<i>Ramesh babu</i>	<i>Basic Mechanical Engineering</i>	<i>VRB Publishers Pvt. Ltd, 2007.</i>

**REFERENCE BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>R.C.Smith</i>	<i>Materials of Construction</i>	<i>Mc Graw Hill Publications, 1973.</i>
<i>Janardhana Jha</i>	<i>Engineering materials</i>	<i>Khanna Publishers, New Delhi, 1981.</i>
<i>P.C.Varghese</i>	<i>Building Materials</i>	<i>PHI Learning pvt. Ltd, New Delhi, 2015</i>
<i>K.S.Jagadish, B.V.</i>	<i>Alternative Building</i>	<i>New Age International (P) Ltd.</i>
<i>Venkataraman Reddy and K.S. Nanjunda Rao</i>	<i>Materials and Technologies</i>	<i>Publishers, New Delhi.</i>
<i>NPTEL Resource material</i>	<i>Building Materials and Construction</i>	
<i>Nagpal G.R</i>	<i>Power Plant Engineering</i>	<i>Khanna Publishers, New Delhi, 2002.</i>
<i>Jain R.K</i>	<i>Production Technology</i>	<i>Khanna Publishers, New Delhi, 2004</i>
<i>Shanmugam.G</i>	<i>Basic Mechanical Engineering</i>	<i>McGraw Hill Education (India) Pvt. Ltd, New Delhi, 4<sup>th</sup> Edition, 2013.</i>

**COURSE OUTCOMES:**

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

**CO1:** Understand the types, basic properties, uses of basic building materials.

**CO2:** Understand the importance of water supply systems and disposal of sewages.

**CO3:** Understand the basics of irrigation and transportation engineering.

**CO4:** Apply the principles of mechanical engineering in their respective field of specialization.

**CO5:** Appreciate the importance of energy generation.

**CO6:** Apply the concept of manufacturing and metal cutting processes in engineering in their applications.

**Course Articulation Matrix**

CO/PO	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
CO 1	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	H	-	-	-	-	-	-	-	-	-	-	-	L	-	-
CO 5	-	-	H	-	-	M	L	L	M	-	-	-	H	M	L
CO6															
16NES105	-	-	H	-	-	M	H	-	-	-	M	-	M	H	M

**L- Low, M – Moderate (Medium), H - High**



**16NBS106****CHEMISTRY LAB***(Common to EEE, ECE, EIE, CSE & IT branches)***Category : BS****L T P C****0 0 4 2****Pre-Requisites: Nil****Course Objectives:**

- The course is aimed at imparting knowledge of experimental techniques which would be useful for students to apply the practical principles relevant conventional engineering field.

**LIST OF EXPERIMENTS**

1. Estimation of hardness by EDTA method
2. Estimation of chloride by Argentometric method
3. Determination of dissolved oxygen by Winkler's method
4. Conductometric titration of mixture of strong acid and weak acid using strong base
5. Potentiometric titration of ferrous iron by dichromate
6. Estimation of copper in brass by EDTA method
7. Estimation of Iron by Spectrophotometry
8. Estimation of HCl by pH titration.

**Contact Periods:****Lecture: 0 Periods    Tutorial: 0 Periods    Practical: 60 Periods    Total: 60 Periods****REFERENCE BOOKS****AUTHOR NAME****TITLE OF BOOK****PUBLISHER,****YEAR OF PUBLICATION***A.O. Thomas**Practical Chemistry**Scientific Book Centre,  
Cannanore, 2003.**Jeffery G H, Basset J.**Vogel's Text book of quantitative  
analysis, 5<sup>th</sup> Edition**EBS, 1988.**Menthom J, Denney R.C.***COURSE OUTCOMES:**

Upon completion of this practical classes, the students will be able to

**CO1:** Understand the nature of hardness, chloride level, pollution level using dissolved oxygen content, iron present in water and analyse them in water.**CO2:** Apply the EMF and conductometric measurements in quantitative analysis of substances.**Course Articulation Matrix**

CO/PO	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
<b>CO1</b>	H	M	L	L	M	L	L	L	L	M	L	M	M	L	L
<b>CO2</b>	H	M	L	L	H	L	L	L	L	M	L	M	M	L	L
<b>16NBS106</b>	H	M	L	L	M	L	L	L	L	M	L	M	M	L	L

**L- Low, M – Moderate (Medium), H – High**

16NES107

**WORKSHOP PRACTICE**

**Category : ES**

( Common to *EEE, ECE, EIE, CSE & IT branches*)

**L T P C**

**0 0 4 2**

**Pre-Requisites: Nil**

**Course Objectives:**

- To make various basic prototypes in the carpentry trade such as Lap joint, Lap Tee joint, Dove tail joint, Mortise & Tenon joint and Cross-Lap joint.
- To make various welding joints such as Lap joint, Lap Tee joint, Edge joint, Butt joint and Corner joint.

**LIST OF EXPERIMENTS**

1. Introduction to use of tools and equipments in Carpentry, Welding, Foundry and Sheet metal
2. Safety aspects in Welding, Carpentry and Foundry
3. Half lap Joint and Dovetail Joint in Carpentry
4. Welding of Lap joint, 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. Electrical wiring – simple house wiring
8. Plumbing

**Contact Periods:**

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

**COURSE OUTCOMES:**

Upon completion of this practical classes, the students will be able to

**CO 1:** Use tools and equipments used in Carpentry, Welding, Foundry and Sheet metal.

**CO 2:** Make half lap joint and dovetail joint in carpentry.

**CO 3:** Make welded lap joint, butt joint and T-joint.

**CO 4:** Prepare sand mould for cube, conical bush, pipes and V pulley.

**CO 5:** Fabricate parts like tray, frustum of cone and square box in sheet metal

**CO 6:** Carry out minor works/repair related to electrical wiring and plumbing.

**Course Articulation Matrix**

CO/PO	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
<b>CO 1</b>	M	-	-	-	-	M	M	-	M	L	-	M	M	M	L
<b>CO 2</b>	M	H	M	-	-	M	L	-	M	L	-	M	M	M	L
<b>CO 3</b>	M	H	M	-	-	M	L	-	M	L	-	M	M	M	L
<b>CO 4</b>	M	H	M	-	-	M	L	-	M	L	-	M	M	M	L
<b>CO 5</b>	M	H	M	-	-	M	L	-	M	L	-	M	M	M	L
<b>CO6</b>	M	H	L	-		M	L		M	L	-	M	M	M	L
<b>16NES107</b>	M	H	M	-	-	M	L	-	M	L	-	M	M	M	L

**L- Low, M – Moderate (Medium), H - High**

16NHS2Z1

**TECHNICAL ENGLISH**  
( Common to all branches)

**Category : HS**  
L T P C  
2 2 0 3

**Pre-Requisites: Nil**

**Course Objectives:**

- To make learners acquire guided listening and speaking skills in both formal and informal contexts.
- To help them develop reading skills by familiarizing them with different types of reading tasks and strategies
- To make them understand advance level of grammar and equip them with writing skills needed for academic as well as workplace contexts.
- To explore the learner to Technical English and Technical Vocabulary.

**UNIT I**

**6+6 Periods**

**Listening** - Listening to ask for/ give opinions, Listening to persuade/dissuade people, Listening to make complaints, Listening to transfer information; **Speaking** –Role play activities on a formal/corporate context, Delivering Welcome Address- **Reading** – Reading to infer lexical and contextual meaning; **Writing** - Effective use of SMS on Whatsapp/ Hike/ Messenger, Writing E-mails on a business context, Technical style; **Grammar** – Use of relative / reflexive pronouns, Discourse Markers; **Vocabulary**- Homonyms and Homophones.

**UNIT II**

**6+6 Periods**

**Listening** - Listening to express regrets/sympathy/condolences, Listening and Note-taking; **Speaking** – Addressing at an official meeting to deal with problems/ sensitive issues, Discussion on a movie with a poignant social message/ or on a recently read book; **Reading** - Reading a short story or an article from newspaper; **Writing** - Writing a review of a book/movie/music concert/sports event, Graph Description; **Grammar** – Noun/Adjective/Adverbial phrases, Cause and effect expressions; **Vocabulary** - Using phrasal verbs in sentences, Jargon.

**UNIT III**

**6+6 Periods**

**Listening** - Listening to a talk about using quantities, Listening to describe manner and frequency, Listening to expressions of assumptions/inference, Listening to make comparisons; **Speaking** – Making conversation to practice stress, pause, pronunciation and intonation, Introducing the chief-guest; **Reading** - Speed reading – reading passages with time limit - **Writing** – Notice, Agenda and Minutes of meetings; - Elements of Writing Technical articles –**Grammar** - Numerical expressions, Conditional clauses; **Vocabulary** - Same word used as different parts of speech, Register.

**UNIT IV**

**6+6 Periods**

**Listening** - Listening to talks about future events/plans, Listening to a talk about making arrangements, Listening to language of reporting, Viewing a model discussion; **Speaking** – Discussion on a formal/corporate context, Proposing vote of thanks; **Reading** - Reading the job advertisements and the profile of the company concerned; **Writing** - Process Description, Applying for a job with résumé; **Grammar** - Direct and indirect speech; **Vocabulary** – Idioms.

**UNIT V**

**6+6 Periods**

**Listening** – Listening to expressions of possibility, Listening to expressions of obligations, Listening to expressions of ability, Viewing model interviews; **Speaking** - Mock interview; **Reading** - Note making, Intensive reading; **Writing** – Checklist, - Feasibility / Project report; **Grammar** – Time Statements and Contracted Time Statements; **Vocabulary** – Nominal Compounds.

**Contact Periods:**

**Lecture: 30 Periods    Tutorial: 30 Periods    Practical: 0 Periods    Total: 60 Periods**

**TEXT BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>Department of English, Anna University. Mindscapes</i>	<i>English for Technologists and Engineers.</i>	<i>Orient Blackswan, Chennai. 2012</i>
<i>Sadanand, Kamlesh &amp; Punitha, Susheela</i>	<i>Spoken English: A Foundation Course (Part 2).</i>	<i>Orient Blackswan, Hyderabad. 2014</i>

**REFERENCE BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>Raman, Meenakshi &amp; Sangeetha Sharma</i>	<i>Technical Communication: Principles and Practice</i>	<i>Oxford University Press, New Delhi. 2011</i>
<i>Vijay, Anbazhagan.J, &amp; Jaishree.N</i>	<i>Technical English-II</i>	<i>Global Publishers, Chennai, 2016</i>
<i>Rizvi, Ashraf. M.</i>	<i>Effective Technical Communication</i>	<i>Tata McGraw-Hill, New Delhi. 2005</i>
<i>Herbert, A.J</i>	<i>Structure of Technical English</i>	<i>The English Language Society, London. 1971</i>
<i>Michigan, E.A</i>	<i>Word Power and Speed Reading: English Improvement Series</i>	<i>Infinity Books, New Delhi, 2007</i>
<i>Rajendrapal &amp; Korlahalli. J.S</i>	<i>Essentials of Business Communication</i>	<i>Sultan Chand &amp; Sons</i>

**WEBSITES**

1. <http://www.usingenglish.com>
2. <http://www.uefap.com>

**COURSE OUTCOMES:**

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

- CO1:** The learners will be able to speak convincingly at work place and social contexts through guided listening tasks and different genres and strategies of reading.
- CO2:** The learner will understand advance level of grammar and write professionally to a larger extent for workplace and general contexts.
- CO3:** The learners will familiarize themselves with Technical Vocabulary and Technical English.

**Course Articulation Matrix**

<b>CO/PO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO1</b>	-	-	L	-	L	M	-	-	-	-	M	-	-	-	L
<b>CO2</b>	-	-	-	-	-	-	-	-	-	H	-	-	-	-	-
<b>CO3</b>															
<b>16NHS2Z1</b>	-	-	L	-	L	L	-	-	-	L	L	-	-	-	L

**L- Low, M – Moderate (Medium), H - High**

**16NBS2Z2****ENGINEERING MATHEMATICS II****Category : BS***(Common to all branches)*

L T P C

3 2 0 4

**Pre-Requisite:** Basics of-trigonometry-differential and integral formulae.**Course Objectives:**

- To acquire knowledge of techniques of ordinary differential equations leading to engineering problems.
- To acquire knowledge of vector Calculus with engineering applications.
- To gain standard techniques of complex variable applicable to fluid dynamics, heat conduction, and elasticity.
- To develop skill of solving transforms leading to engineering applications.

**UNIT I ORDINARY DIFFERENTIAL EQUATIONS 9+6 Periods**

Second and Higher order Differential Equations, Method of variation of parameters- Method of undetermined coefficients-Homogeneous equations of Euler's and Legendre's type-System of Simultaneous first order Linear equations with constant coefficients - Method of reduction of order.

**UNIT II VECTOR CALCULUS 9+6 Periods**

Gradient and directional derivative, Divergence and Curl – Irrotational and Solenoidal fields- Vector identities - Line, Surface and Volume Integrals – Green's Theorem in a Plane , Gauss Divergence and Stoke's Theorems (Statements only) –Verifications and Applications.

**UNIT III COMPLEX DIFFERENTIATION 9+6 Periods**

Functions of a Complex variable-Analytic functions- Cauchy Riemann equations and sufficient conditions (excluding proof)–Harmonic conjugates–Construction of analytic functions-Conformal mappings:  $w=z+a$ ,  $az$ ,  $1/z$ ,  $z^2$ ,  $e^z$ ,  $\sin z$ ,  $\cos z$  and Bilinear Transformation.

**UNIT IV COMPLEX INTEGRATION 9+6 Periods**

Cauchy's integral theorem, Cauchy's integral formula -Taylor's and Laurent's theorems (Statements only) and expansions – Poles and Residues – Cauchy's Residue theorem – Contour integration – Circular and semi circular contours with no pole on real axis.

**UNIT V LAPLACE TRANSFORMATIONS 9+6 Periods**

Laplace transforms- Properties and standard transforms-Transforms of unit step, unit Impulse and error functions –Transforms of periodic functions- Inverse Laplace transforms- Initial and Final value theorems- Convolution theorem (Statement only) and applications - Applications to Solution of Linear differential equations of second order with constant coefficients.

**Contact Periods:****Lecture: 45 Periods    Tutorial: 30 Periods    Practical: 0 Periods    Total: 75 Periods****TEXT BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>Veerarajan T</i>	<i>Engineering Mathematics'' for Semesters I and II</i>	<i>Tata McGraw Hill Publishing Co., New Delhi, 2015.</i>
<i>Kandasamy P, Thilagavathy K and Gunavathy K</i>	<i>Engineering Mathematics'' for I year B.E/B.Tech</i>	<i>S.Chand &amp; Co, Ramnagar, New Delhi, Reprint 2013.</i>
<i>S. Narayanan and Manicavachagom Pillai T.K.</i>	<i>Calculus-Vol.III</i>	<i>S. Viswanathan, Printers and Publishers Pvt. Ltd, Chennai, 2009.</i>

## REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
<i>Erwin Kreyszig</i>	<i>Advanced Engineering Mathematics</i>	<i>Wiley &amp; sons(Asia) Ltd, 10<sup>th</sup> Edition, 2015.</i>
<i>Ray Wylie.C and Louis Barrett</i>	<i>Advanced Engineering Mathematics</i>	<i>Tata McGraw Hill Company, New Delhi, 2004.</i>
<i>Grewal B. S</i>	<i>Higher Engineering Mathematics</i>	<i>Khanna Publishers, New Delhi, 43<sup>rd</sup> Edition, 2014.</i>
<i>Ramana B V</i>	<i>Higher Engineering Mathematics</i>	<i>Tata McGraw Hill Co. Ltd, NewDelhi, 11<sup>th</sup> Print, 2010.</i>
<i>Bali N., Goyal M and Watkins C</i>	<i>Advanced Engineering Mathematics</i>	<i>Firewall Media (An Imprint of Laxmi Publications Pvt Ltd), New Delhi, 7<sup>th</sup> Edition,2009.</i>
<i>Bali N.P and Goyal M</i>	<i>A text book of Engineering Mathematics</i>	<i>University Science Press (An Imprint of Laxmi Publications Pvt Ltd), New Delhi,2014.</i>

## COURSE OUTCOMES:

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

**CO1:** Understand the kinds of differential equations and their solutions in the field of engineering.

**CO2:** Evaluate gradient, divergence and curl and also line, surface and volume integrals in cartesian form and simple coordinate systems and calculate integrals applying Greens, Stokes and Gauss theorems.

**CO3:** Understand the concepts of analytic functions and conformal mappings.

**CO4:** Evaluate contour integrals using calculus of residues.

**CO5:** Apply Laplace transform methods to solve differential equations.

### Course Articulation Matrix

CO/PO	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
CO 1	H	H	H	H	-	-	-	-	-	M	H	H	M	H	M
CO 2	H	H	M	M	-	-	-	-	-	M	-	M	M	H	M
CO 3	H	H	M	H	-	M	-	-	-	M	M	M	L	L	L
CO 4	H	H	M	M	-	M	-	-	-	M	M	M	L	M	L
CO 5	H	H	M	H	-	H	-	-	-	M	M	H	M	H	M
16NBS2Z2	H	H	M	H	-	M	-	-	-	M	M	M	M	H	M

**L- Low, M – Moderate (Medium), H – High**

**Pre-Requisite: Nil****Course Objectives:**

To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology. Upon completion of this course the students will be familiar with:

- The properties of conducting materials.
- The application of magnetic and super conducting materials.
- Application and properties of dielectric and ferro electric materials.
- Applications and properties of Modern engineering materials.
- Nano materials and its properties.

**UNIT I CONDUCTING MATERIALS 9 Periods**

Introduction to Conductors – classical free electron theory of metals – Draw backs of classical theory – quantum theory - Electrical and Thermal conductivity of Metals – Derivation for Wiedeman – Franz law – Lorentz number — Fermi distribution function - effect of temperature – density of energy states – calculation of Fermi energy- carrier concentration in metals.

**UNIT II SEMICONDUCTING MATERIALS AND DEVICES 9 Periods**

Introduction – Properties – elemental and compound semiconductors - Intrinsic and extrinsic semiconductors – properties - Carrier concentration in intrinsic Semiconductor - variation of Fermi level with temperature and carrier concentration - Electrical Conductivity – band gap determination - extrinsic semiconductors - Carrier concentration in P- type and N-type semiconductors – variation of Fermi level with temperature and impurity concentration – Hall effect- Determination of Hall Co-efficient in N type and P type Semiconductor - Applications.

**UNIT III MAGNETIC AND SUPER CONDUCTING MATERIALS 9 Periods**

Introduction - Origin of magnetic moment - Bohr magneton - Dia, Para, and Ferro magnetic materials - Domain theory of ferromagnetism - Hysteresis - Hard and Soft magnetic materials. Ferrites - structure and applications. - Magneto optical recording and readout – Superconductivity - Types of superconductors - BCS theory of superconductivity (qualitative) - properties- High Tc superconductors, Applications of superconductors- SQUID, Cryotron, Magnetic levitation.

**UNIT IV DIELECTRICS AND FERROELECTRICS 9 Periods**

Introduction to dielectric materials – Electric polarization and Dipole moment - Electrical susceptibility – dielectric constant – Various polarization mechanisms in dielectrics - electronic, ionic, orientational and space charge polarization– frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – Applications of dielectric materials - Ferro electricity –Ferro electric materials -BaTiO<sub>3</sub> – Applications- Ferro electric energy converter.

**UNIT V MODERN ENGINEERING MATERIALS 9 Periods**

Metallic glasses- preparation of metallic glasses - properties – applications of the metallic glasses - Shape Memory Alloys (SMA) - Characteristics, properties of NiTi alloy - applications of the Shape memory alloys - advantages and disadvantages of SMA - Nanomaterials-synthesis –chemical vapour deposition – Sol Gel – ball Milling – properties of nanoparticles and applications of nanoparticles – Carbon Nanotubes (CNT) – structure – properties – applications of CNTs.

**Contact Periods:**

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

**TEXT BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>P.K.Palanisamy</i>	<i>Engineering Physics–II</i>	<i>Scitech Publications (India ) Pvt. Ltd 2015 (Unit I, Unit III &amp; Unit IV)</i>
<i>Dr.Jayakumar .S</i>	<i>Materials science</i>	<i>R.K.Publishers,2008.(Unit II &amp; IV)</i>
<i>Dr.V.Rajendran</i>	<i>Material Science</i>	<i>Tata McGraw Hill Publications, NewDelhi, 2011.</i>

**REFERENCE BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>Charles P.Poole, Jr; Frank J.Owens</i>	<i>Introduction to Nanotechnology</i>	<i>Wiley India, 2012.</i>
<i>Gaur R.K. and Gupta S.L K.Rajagopal</i>	<i>Engineering Physics Engineering Physics</i>	<i>Dhanpat Rai Publishers, 2009. PHI Learning Private Ltd, New Delhi, 2015.</i>

**COURSE OUTCOMES:**

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

**CO1:** Analyze the properties of conducting materials. [**Familiarity**]

**CO2:** List and analyze the properties of Semiconducting materials and Devices. [**Familiarity**]

**CO3:** Identify, analyze the properties and applications of magnetic & super conducting materials. [**Familiarity**]

**CO4:** List and analyze the properties of dielectric Ferro electric materials. [**Familiarity & Application**]

**CO5:** List the properties and applications of modern engineering materials. [**Familiarity & Application**]

**Course Articulation Matrix**

<b>CO/PO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H
<b>CO 2</b>	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H
<b>CO 3</b>	H	H	M	M	M	M	M	-	-	-	-	-	H	H	H
<b>CO 4</b>	H	H	H	H	H	M	H	-	-	-	-	-	H	H	H
<b>CO 5</b>	H	H	M	M	M	H	M	-	-	-	-	-	H	H	H
<b>16NBS2Z3</b>	H	H	M	M	M	M	M	-	-	-	-	-	H	H	H

L- Low, M – Moderate (Medium), H - High



16NHS2Z4

ENVIRONMENTAL SCIENCE AND ENGINEERING

(Common to all branches)

Category : HS

L T P C

3 0 0 3

**Pre-Requisite: Nil**

**Course Objectives:**

- The course is aimed at creating awareness among students and also to inculcate the critical ideas of preserving environment.

**UNIT I ENVIRONMENTAL RESOURCES 9 Periods**

Natural resources -Forest – benefits, over exploitation, deforestation & consequences – Water - unique features, hydrological cycle & over exploitation – Food -effect of modern agriculture, fertilizers, pesticides, eutrophication & biomagnifications - Energy resources - renewable & non-renewable resources - wind, solar and tidal - harnessing methods.

**UNIT II ECO SYSTEM AND BIODIVERSITY 9 Periods**

Ecology - ecosystem, physical and chemical components of ecosystem, biological components of ecosystem - forest ecosystem, desert ecosystem and pond ecosystem, Energy flow in ecosystem, nitrogen cycle and carbon dioxide cycle, food pyramid, ecological succession, Biodiversity - types, values of biodiversity, hot spots of biodiversity, endangered and endemic species, conservation of biodiversity – in situ – ex situ conservation.

**UNIT III ENVIRONMENTAL POLLUTION 9 Periods**

Air pollution, classification of air pollutants – sources, effects and control of gaseous pollutants SO<sub>2</sub>, NO<sub>x</sub>, H<sub>2</sub>S, CO, CO<sub>2</sub> and particulates, control methods - cyclone separator and electrostatic precipitator - Water pollution - classification of water pollutants, organic and inorganic pollutants, sources, effects and control of water pollutants Soil pollution - sources, effects and control - Noise pollution - decibel scale, sources, effects and control.

**UNIT IV ENVIRONMENTAL THREATS 9 Periods**

Acid rain, greenhouse effect, global warming and ozone depletion, disaster management, flood, drought, earthquake and tsunami, Threats to biodiversity - destruction of habitat, habitat fragmentation - hunting, over exploitation and man - wildlife conflicts, The IUCN red list categories, status of threatened species.

**UNIT V SOCIAL ISSUES AND ENVIRONMENT 9 Periods**

Sustainable development - sustainable technologies, need for energy and water conservation, rain water harvesting, water shed management, waste land reclamation, Pollution control Act, Wild life protection act, Forest conservation 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, HIV/AIDS - effects and preventive measures.

**Contact Periods:**

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

**TEXT BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
Sharma J.P	“Environmental Studies”, 3 <sup>rd</sup> Edition	University Science Press, New Delhi 2009.
Anubha Kaushik and C.P. Kaushik	“Environmental Science and Engineering”, 3 <sup>rd</sup> Edition	New age International Publishers, New Delhi, 2008.

**REFERENCE BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
R.K. Trivedi	Hand book of Environmental laws, Rules, Guidelines, Compliances and Standards”, Vol.I&II,	Environ Media, 2006.
G. Tyler Miller Jr	“Environmental Science”, 10 <sup>th</sup> Edition	Thomson Brooks/Cole Publishing, 2004.
Gilbert M. Masters	Introduction to Environmental Engineering and Science, 2 <sup>nd</sup> Edition	Pearson Education, 2004.

**COURSE OUTCOMES:**

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

- CO1:** To know about the various environmental resources, the effective utility and problems accompanied in over exploitation.
- CO2:** To acquire knowledge about the interaction of biosphere with environment and conservation methods of bio diversity.
- CO3:** To be aware of the source of various types of pollution, their ill effects and preventive methods.
- CO4:** To understand the environmental threats, Acid rain, Green house effect and Ozone depletion and natural disasters.
- CO5:** To create an idea about sustainable development and social issues.

**Course Articulation Matrix**

<b>PO/CO</b>	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>	<b>PO 6</b>	<b>PO 7</b>	<b>PO 8</b>	<b>PO 9</b>	<b>PO 10</b>	<b>PO 11</b>	<b>PO 12</b>	<b>PSO 1</b>	<b>PSO 2</b>	<b>PSO 3</b>
<b>CO 1</b>	L	M	M	L	L	L	L	L	L	L	L	M	L	L	M
<b>CO 2</b>	L	L	H	L	L	L	M	M	L	M	L	M	L	L	L
<b>CO 3</b>	L	L	L	M	L	L	M	L	L	L	L	M	L	L	L
<b>CO 4</b>	L	L	L	L	L	L	H	M	L	L	L	M	L	L	M
<b>CO 5</b>	L	L	M	L	L	L	H	H	L	L	L	M	L	L	M
<b>16NHS2Z4</b>	L	L	M	L	L	L	M	M	L	L	L	M	L	L	M

**L- Low, M – Moderate (Medium), H – High**

16NES2Z5

**PROGRAMMING IN C**  
(Common to all branches)

**Category : ES**  
L T P C  
3 0 0 3

**Pre-Requisites: Nil**

**Course Objectives:**

Upon completion of this course, the students will be familiar with,

- The Computer and Programming fundamentals
- Data types in C and Flow control statements
- Functions, Arrays, Pointers And Strings
- Bitwise Operators, Preprocessor Directives, Structures and Unions
- Structures, List Processing, Input and Output

**UNIT I COMPUTER AND PROGRAMMING FUNDAMENTALS 9 Periods**

Computer fundamentals – Evolution, classification, Anatomy of a computer: CPU, Memory, I/O – Introduction to software – Generation and classification of programming languages – Compiling – Linking and loading a program – Translator – loader – linker – develop a program – software development – Introduction to OS –Types of OS – Algorithms – Structured programming concept.

**UNIT II DATA TYPES AND FLOW OF CONTROL 9 Periods**

An overview of C – Programming and Preparation – Program Output – Variables – Expressions, and Assignment, The use of #include, printf(), scanf() – Lexical elements, operators and the C systems – The fundamental data types – Flow of control.

**UNIT III FUNCTIONS, ARRAYS, POINTERS AND STRINGS 9 Periods**

Functions and storage classes - 1D Arrays – Pointers – Call by reference – Relationship between Arrays and Pointers – Pointer arithmetic and element size – Arrays as function argument – Dynamic memory allocation – Strings – String handling functions – Multidimensional Arrays.

**UNIT IV ARRAY OF POINTERS, BITWISE OPERATORS, PREPROCESSOR DIRECTIVES 9 Periods**

Arrays of Pointers – Arguments to main () - Ragged Arrays – Functions as Arguments – Arrays of Pointers to Functions - Type qualifiers.-Bitwise operators and expressions – Masks – Software tools – Packing and unpacking – Enumeration types – The preprocessor directives.

**UNIT V STRUCTURES AND UNIONS, I/O AND FILE OPERATIONS 9 Periods**

Structures and Unions – Operator precedence and associativity – Bit fields – Accessing bits and bytes - Input and Output functions – File Processing Functions – Environment variables – Use of make and touch.

**Contact Periods:**

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

**TEXT BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>Pradip Dey, Manas Ghosh</i>	<i>Computer Fundamentals and Programming in C, Second Edition</i>	<i>Oxford University Press, 2013.</i>
<i>Al Kelley, Ira Pohl</i>	<i>A Book on C-Programming in C, Fourth Edition</i>	<i>Addison Wesley, 2001.</i>

## REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
Stephen G. Kochan	Programming in C-A complete introduction to the C programming language, Third Edition	Sams Publication, 2004.
Yashavant P. Kanetkar	Let Us C, 13 <sup>th</sup> edition	BPB Publications, 2013.
Brian W. Kernighan and Dennis Ritchie	The C Programming Language”, Second Edition	Prentice Hall Software Series, 1988.
Stephen Prata	C Primer Plus, Fifth Edition	Sams Publishing, 2005.

## COURSE OUTCOMES:

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

**CO1:** Articulate the programming environment [**Familiarity**]

**CO2:** Write algorithm for solving the given problem statement [**usage**]

**CO3:** Use right data types and flow control statement [**Assessment**]

**CO4:** Write programs using functions, arrays, pointers and strings [**Usage**]

**CO5:** Use right storage classes, preprocessor directives, bitwise operators in programs [**Assessment**]

**CO6:** Use structures, unions and files [**Usage**]

## Course Articulation Matrix

PO/CO	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
CO 1	H	H	M	H	H	-	M	M	M	M	L	M	M	M	L
CO 2	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO 3	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO 4	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO 5	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
CO6	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L
16NES2Z5	H	H	M	H	H	-	M	M	M	M	L	M	M	M	L

**L- Low, M – Moderate (Medium), H - High**

16NES206

**ENGINEERING MECHANICS**

Category : ES

(Common to all except ECE, CSE and IT branches)

L T P C

3 2 0 4

**Pre-Requisites: Nil**

**Course Objectives:**

- To analyze the force systems, friction and to study the dynamics of particles, impulse and momentum.

**UNIT I INTRODUCTION TO MECHANICS AND FORCE CONCEPTS 9+6 Periods**

Principles and Concepts – Laws of Mechanics – system of forces – resultant of a force system – resolution and composition of forces – Lami’s theorem – moment of a force – physical significance of moment-Varignon’s theorem – resolution of a force into force and couple – forces in space – addition of concurrent forces in space – equilibrium of a particle in space.

**UNIT II FRICTION 9+6 Periods**

Frictional resistance – classification of friction- laws of friction – coefficient of friction-angle of friction – angle of repose — cone of friction – free body diagram-advantages-equilibrium of a body on a rough inclined plane – non-concurrent force system - ladder friction – rope friction – wedge friction.

**UNIT III GEOMETRICAL PROPERTIES OF SECTION 9+6 Periods**

Centroids – Determination by integration – moment of inertia – theorems of moment of inertia – Product of Inertia – Principal moment of inertia of plane areas - radius of gyration.

**UNIT IV BASICS OF DYNAMICS - KINEMATICS 9+6 Periods**

Kinematics and kinetics – displacements, velocity and acceleration - Equations of motion – Rectilinear motion of a particle with uniform velocity, uniform acceleration, varying acceleration – motion curves – motion under gravity – relative motion – curvilinear motion of particles – projectiles – angle of projection – range – time of flight and maximum height.

**UNIT V BASICS OF DYNAMICS - KINETICS 9+6 Periods**

Newton’s second law of motion – linear momentum – D’Alembert’s principle, Dynamics equilibrium — work energy equation of particles– law of conservation of energy – principle of work and energy.

Principle of impulse and momentum – Equations of momentum – Laws of conservation of momentum. Impact – Time of compression, restitution, collision – Co-efficient of restitution – types of impact – collision of elastic bodies by direct central impact and oblique impact – collision of small body with a massive body – Kinetic energy of a particle.

**Contact Periods:**

**Lecture: 45 Periods Tutorial: 30 Periods Practical: 0 Periods Total: 75 Periods**

**TEXT BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>S.S. Bhavikatti and K.G. Rajasekarappa</i>	<i>Engineering Mechanics</i>	<i>New Age International Pvt Ltd. 1999.</i>
<i>S.C. Natesan</i>	<i>Engineering Mechanics</i>	<i>Umesh Publications, 5-B north market, Naisarak, Delhi, 2002.</i>

## REFERENCE BOOKS

AUTHOR NAME	TITLE OF BOOK	PUBLISHER, YEAR OF PUBLICATION
<i>F.B. Beer and E.R. Johnson</i>	<i>Vector Mechanics for Engineers</i>	<i>Tata Mc.Graw Hill Pvt Ltd, 10<sup>th</sup> Edition, 2013.</i>
<i>S. Timoshenko and Young</i>	<i>Engineering Mechanics</i>	<i>Mc.Graw Hill, 4<sup>th</sup> Edition, 1995.</i>
<i>Irving Shames and Krishna Mohana Rao</i>	<i>Engineering Mechanics</i>	<i>Prentice Hall of India Ltd, Delhi, 2006.</i>
<i>Domkundwar V.M and Anand V. Domkundwar</i>	<i>Engineering Mechanics (Statics and Dynamics)</i>	<i>Dhanpat Rai and Co. Ltd, 1<sup>st</sup> Edition, 2006.</i>
<i>Suhas Nitsure</i>	<i>Engineering Mechanics</i>	<i>Technical Publications, Pune, 1<sup>st</sup> edition, 2006.</i>
<i>R.C. Hibbeller</i>	<i>Engineering Mechanics</i>	<i>Prentice Hall of India Ltd, 13<sup>th</sup> Edition, 2013.</i>
<i>Vela Murali</i>	<i>Engineering Mechanics</i>	<i>Oxford university Press, 1<sup>st</sup> Edition, 2010.</i>

## COURSE OUTCOMES:

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

**CO1:** Analyze the problems related to force systems and friction

**CO2:** Apply concepts of centre of gravity and moment of inertia

**CO3:** Solve problems on dynamics, momentum and impulse

## Course Articulation Matrix

PO/CO	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	M	H	M	L	L	-	-	-	L	-	L	-	M	L	M
CO2	L	H	L	-	L	-	-	-	L	-	L	-	L	L	M
CO3	M	H	M	L	L	-	-	-	L	-	L	-	M	L	L
16NES206	M	H	M	L	L	-	-	-	L	-	L	-	M	L	M

**L- Low, M – Moderate (Medium), H - High**

16NBS207

**PHYSICS LABORATORY**  
(Common to EEE, ECE, EIE, CSE & IT branches)

**Category : BS**  
L T P C  
0 0 4 2

**Pre-Requisites: Nil**

**Course Objectives:**

- To have a practical knowledge about the concepts behind physics and the need to apply in the emerging technology.

**LIST OF EXPERIMENTS**

- Spectrometer - Diffraction Grating Normal Incidence Method
- Air Wedge –Determination of thickness of a paper
- Young’s Modulus – Cantilever Bending - Koenig’s Method
- a. Laser - Particle size Determination  
b. Optical fiber - Determination of NA & Acceptance angle
- Ammeter and Voltmeter Calibration – Low Range
- Resistance Of The Given Coil Of Wire – Carey Foster’s Bridge
- Determination of Band gap Energy of Semiconductor
- Ultrasonic Interferometer - Velocity of sound & Compressibility of liquids.
- Transistor Characteristics
- Torsional pendulum –Determination of Rigidity Modulus & Moment of Inertia

**Contact Periods:**

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

**COURSE OUTCOMES:**

Upon completion of this practical classes, the students will be able to

**CO1:** Determinate of all physical properties of any matter, basic idea of calibrating electrical measuring instruments and thereby effectively using it for particular applications.

**CO2:** Experiment intrinsic characteristic features of electronic devices for electrical and electronic applications.

**Course Articulation Matrix**

PO/CO	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
<b>CO1</b>	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H
<b>CO2</b>	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H
<b>16NBS207</b>	H	H	H	H	H	H	H	-	-	-	-	-	H	H	H

**L- Low, M – Moderate (Medium), H - High**

16NES208

**ENGINEERING GRAPHICS**

( Common to EEE, ECE, EIE, CSE & IT branches)

**Category : ES**

**L T P C**

**2 0 4 4**

**Pre-Requisites: Nil**

**Course Objectives:**

- Geometrical constructions
- Orthographic projections.
- Performing section of solids and development of the same.
- Interpretation of solids.
- Pictorial view of solids

**UNIT I GEOMETRICAL CONSTRUCTIONS**

**15 Periods**

Dimensioning-Lettering-Types of Lines-Scaling conventions-Dividing a given straight line in to any number of equal parts- Bisecting a given angle- Drawing a regular polygon given one side-Special methods of constructing a pentagon and hexagon- Construction of curves like ellipse, parabola, cycloid and involute using one method.

**UNIT II ORTHOGRAPHIC PROJECTIONS**

**25 Periods**

Introduction to Orthographic Projection-Projection of points-Projection of straight lines with traces- Projection of planes-Conversion of pictorial views to orthographic views-Projection of solids - Auxiliary projections.

**UNIT III SECTION OF SOLIDS AND DEVELOPMENT**

**20 Periods**

Section of solids- Development of surfaces

**UNIT IV INTERPENETRATION OF SOLIDS AND PICTORIAL**

**20 Periods**

Cylinder and cylinder, cone and cylinder only Isometric projections - Conversion of orthographic views to pictorial views (simple objects).

**UNIT V INTRODUCTION TO AUTOCAD**

**10 Periods**

**Object Construction :** Page layout – Layers and Line types – Creating, Editing and selecting the Geometric Objects. Viewing, Annotating, Hatching and Dimensioning the drawing – Creating Blocks and Attributes.

**Contact Periods:**

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

**REFERENCE BOOKS**

<b>AUTHOR NAME</b>	<b>TITLE OF BOOK</b>	<b>PUBLISHER, YEAR OF PUBLICATION</b>
<i>K.Venugopal</i>	<i>Engineering Graphics</i>	<i>New Age International (P) Limited, 2015.</i>
<i>Dhananjay.A.Jolhe</i>	<i>Engineering Drawing</i>	<i>Tata McGraw Hill Publishing Co., 2007.</i>
<i>K.V.Natarajan</i>	<i>A text book of Engineering Graphics</i>	<i>Dhanalakshmi Publishers, Chennai, 2006.</i>
<i>M.B.Shah and B.C. Rana</i>	<i>Engineering Drawing</i>	<i>Pearson Education, 2005.</i>
<i>Luzadder and Duff</i>	<i>Fundamentals of Engineering Drawing</i>	<i>Prentice Hall of India Pvt Ltd, XI<sup>th</sup> Edition, 2001.</i>
<i>K.L.Narayana and P.Kannaiah</i>	<i>Text book on Engineering Drawing, 2<sup>nd</sup> Edition</i>	<i>SciTech Publications (India) Pvt. Ltd, Chennai, 2009.</i>



**COURSE OUTCOMES:**

Upon completion of this practical classes, the students will be able to

**CO1:** Represent planes and solids as per international standards.

**CO2:** Generate and interpret multiple views through development, interpretation and sectional views.

**CO3:** Generate and interrupt orthographic views.

**CO4:** Generate and interrupt pictorial views and interpenetration.

**CO5:** Generate and interrupt perspective views.

**CO6:** Apply the concept of AUTOCAD in engineering graphics.

**Course Articulation Matrix**

PO/CO	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
<b>CO 1</b>	-	H	H	-	-	M	-	L	H	M	-	M	M	M	L
<b>CO 2</b>	-	-	H	-	-	M	-	L	H	M	-	M	M	M	L
<b>CO 3</b>	-	-	H	-	-	M	-	L	H	M	-	M	M	M	M
<b>CO 4</b>	-	-	H	-	-	M	-	L	H	M	-	M	M	M	M
<b>CO 5</b>	-	-	H	-	-	M	-	L	H	M	-	M	M	M	L
<b>CO6</b>	-	H	H	H	-	M	-	L	H	M	-	M	M	M	M
<b>16NES208</b>	-	L	H	L	-	M	-	L	H	M	-	M	M	M	M

**L- Low, M – Moderate (Medium), H - High**



16NES2Z9

**PROGRAMMING IN C LABORATORY**  
(Common to all branches)

**Category : ES**  
L T P C  
0 0 4 2

**Pre-Requisites: Nil**

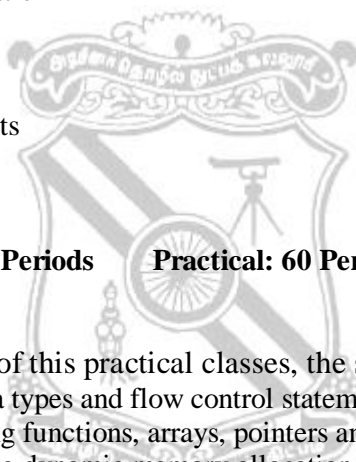
**Course Objectives:**

- Data types in C and Flow control statements
- Functions, Arrays, Pointers And Strings
- Dynamic memory allocation and command line arguments
- Bitwise Operators, Preprocessor Directives, Structures and Unions
- Structures, List Processing, Input And Output

**PRACTICALS**

**EXERCISES ILLUSTRATING THE FOLLOWING CONCEPTS:**

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. Structures
8. Unions
9. Files
10. Command line arguments
11. Mini Project



**Contact Periods:**

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

**COURSE OUTCOMES:**

Upon completion of this practical classes, the students will be able to

**CO1:** Use appropriate data types and flow control statements [**Usage**]

**CO2:** Write programs using functions, arrays, pointers and strings [**Usage**]

**CO3:** Write programs using dynamic memory allocation [**Usage**]

**CO4:** Implement programs using right storage classes, preprocessor directives, bitwise operators [**Usage**]

**CO5:** Work with command line arguments, structures, unions and files [**Usage**]

**CO6:** Develop applications using C [**Usage**]

**Course Articulation Matrix**

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
<b>CO 1</b>	H	H	M	H	H	-	-	M	M	M	L	M	L	L	L	
<b>CO 2</b>	H	H	M	H	H	-	-	M	M	M	L	M	M	L	L	
<b>CO 3</b>	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L	
<b>CO 4</b>	H	H	M	H	H	-	-	M	M	M	L	M	M	M	L	
<b>CO 5</b>	H	H	M	H	H	-	-	M	M	M	H	M	L	L	L	
<b>CO6</b>	H	H	M	H	H	-	-	M	M	M	M	H	M	M	L	
<b>16NES2Z9</b>	H	H	M	H	H	-	-	M	M	M	M	M	M	L	L	

**L- Low, M – Moderate (Medium), H - High**

16NBS3Z1

**ENGINEERING MATHEMATICS III**  
(Common to all Branches)

Category: BS  
L T P C  
3 2 0 4

**Pre-Requisites: Nil**

**Course Objectives:**

- To gain the knowledge of formation of Fourier series.
- To familiarize with Infinite and finite Fourier transforms functions.
- To be familiar with solution of first and second order differential equations.
- To acquire knowledge of techniques to solve one and two dimensional partial differential equations concerning to engineering applications.

**UNIT- I FOURIER SERIES (9+6)**

Dirichlet's conditions - Full range Expansions - Odd and even functions - Half range sine and cosine series – Parseval's identity on a Fourier series - Harmonic analysis.

**UNIT- II FOURIER TRANSFORMS (9+6)**

Fourier integral theorem (statement only) - Infinite Fourier transform pair - Fourier sine and cosine transform pair - Properties -Transforms of simple functions - Parseval's identity on a Fourier transform - Finite Fourier transforms.

**UNIT- III PARTIAL DIFFERENTIAL EQUATIONS (9+6)**

Formation of partial differential equations - First order PDE - Standard types and Lagrange's type - Linear partial differential second and higher order with constant coefficients - Homogeneous and Non-homogeneous types.

**UNIT- IV BOUNDARY VALUE PROBLEMS (9+6)**

Method of separation of variables and Fourier series solution: One dimensional wave equation, one and two dimensional heat flow.

**UNIT- V Z TRANSFORMS (9+6)**

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

**Contact Periods:**

**Lecture: 45 Periods Tutorial: 30Periods Practical: 0 Periods Total: 75 Periods**

**Text Books**

Author Name	Title of Book	Publisher, Year of Publication
Veerarajan T	<i>Transforms and partial differential equations</i>	Tata McGraw Hill Publishing Co., New Delhi, 2015
Kandasamy, Thilagavathy and Gunavathy	<i>Engineering Mathematics for semester III B.E/B.Tech</i>	S.Chand & Co, Ramnagar, New Delhi, 2013

**Reference Books**

1. Grewal B .S, "Higher Engineering Mathematics" Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Ramana B. V, "Higher Engineering Mathematics" Tata McGraw Hill Co. Ltd., New Delhi, 11th Edition, Reprint, 2010.
3. Bali N., Goyal M, "Transforms and Partial differential equations" University Science Press, New Delhi, 2010
4. Ray Wylie C and Louis C Barrett, "Advanced Engineering Mathematics", McGraw Hill Education(India) Pvt Ltd, New Delhi, 6th Edition, Reprint, 2014.
5. Donald.A.McQuarrie,, "Mathematical Methods for Scientists and Engineers", Viva Books Pvt. Ltd., New Delhi, 1st Edition, Reprint, 2015.

### Course Outcomes

On completion of this course, students will be able to

**CO 1:** Understand the concepts of Fourier series and its construction when discrete and continuous form is known.

**CO 2:** Acquire fluency in Fourier transforms in order to solve improper integrals.

**CO 3:** Understand the standard and special types of partial differential equations.

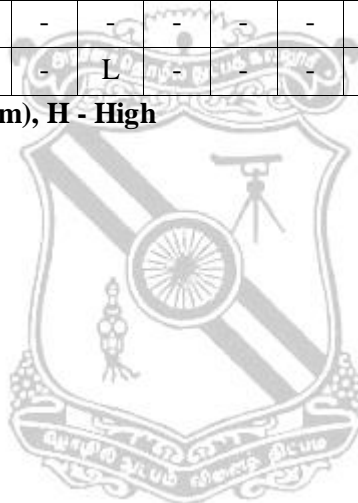
**CO 4:** Gain fluency in solving boundary value problems.

**CO 5:** Understand the Z transform methods to find solutions of difference equations.

### Course Articulation Matrix

PO/PSO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	H	H	H	-	-	-	-	-	-	H	-	-	H	L	M
CO 2	M	H	M	-	-	-	-	-	-	M	-	-	M	L	M
CO 3	H	M	-	-	-	-	-	-	-	L	-	-	H	L	M
CO 4	H	H	M	-	-	M	-	-	-	M	M	-	H	L	M
CO 5	M	M	M	-	-	-	-	-	-	-	-	-	M	L	M
16NES3Z1	H	H	M	-	-	L	-	-	-	M	L	-	M	L	M

**L- Low, M – Moderate (Medium), H - High**



**16NES302 THERMAL ENGINEERING AND FLUID MECHANICS Category: ES**  
(Common to EEE)

<b>Pre- Requisite</b>	L	T	P	C
1. 16NES105 Basics of Civil and Mechanical Engineering	4	0	0	4

**COURSE OBJECTIVES**

- \* To identify, formulate and solve engineering problems in classical thermodynamics involving closed and open systems for both steady state and transient processes.
- \* To analyse problems using fluid mechanics.

**SECTION A: THERMAL ENGINEERING**

**UNIT - I : BASIC CONCEPTS OF THERMODYNAMICS 10**

Basic definitions of thermodynamics - Point and Path functions – Study of Closed and Open systems, Steady flow processes – Applications - Kelvin Plank and Clausis statements, Heat engines, Refrigerators, Heat pumps, Efficiency and COP.

**UNIT - II : THERMODYNAMIC CYCLES 10**

Otto, Diesel, Dual and brayton cycles, Air-Standard efficiency, Mean effective pressure PV and TS diagrams - Applications. Performance testing of I.C Engines – Applications.

**UNIT - III : AIR COMPRESSORS 10**

Reciprocating compressors - effect of clearance - multi staging - optimum intercooler pressure and perfect intercooling - rotary compressors - centrifugal, axial flow compressors- problems.

**Contact Periods:**

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

**Text Books :**

- 1 Nag, P.K “*Engineering Thermodynamics*” Tata McGraw Hill Publishing Company, New Delhi
- 2 Domkundwar and Kothandaram “*Thermal Engineering*” S. Chand and Co., 1996

**Reference Books:**

- 1 Rajput R.K “*Thermal Engineering*” Laxmi Publications (P) Ltd.
- 2 Rai, K.S. & Sarao, “*Thermal Engineering*” Satya Prakashan 1990.
- 3 Sarkar, B.K, “*Thermal Engineering*” Tata McGraw Hill Co., Ltd.1998.
- 4 Ramalingam, K.K., “*Internal Combustion Engines-Theory and Practice* Scitech Publications 1999.
- 5 Ganesan V “*Internal Combustion Engines*” Tata McGraw Hill, New Delhi, 1994

**SECTION B: FLUID MECHANICS**

**UNIT - I : FLUID PROPERTIES 08**

Units and Dimensions – Fluid properties – Density, Specific gravity, Viscosity, Surface tension, capillarity – Pascal’s law – Pressure measurements – Piezometer ,Manometers

**UNIT - II : EQUATIONS OF FLUID FLOW 12**

Types of fluid flow – Types of flow line – Control volume – Continuity equation – One dimensional and three dimensional form – Energy equation – Euler and Bernoulli’s equations – Applications – Impulse momentum equation (principle only).

**UNIT - III : INTRODUCTION TO HYDRAULIC MACHINES 10**

Hydraulic Turbines – Classifications – Constructions and working principles of Pelton wheel, Francis and Kaplan Turbines – Specific speed - Pumps – Classifications – Centrifugal pump – Working

principle – Performance curves – Specific speed - Reciprocation pump – Components and working – Jet pump – Gear pump – Submersible pump.

**Contact Periods:**

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

**Text Books :**

- 1 Rajput.R.K. “*A Text Book of Fluid Mechanics and Hydraulic machines*” S.Chand and company, New Delhi,2002
- 2 Kumar.K.L. “*Engineering Fluid Mechanics*” Eurasia Publishing House (P) Ltd. New Delhi,2000.

**Reference Books:**

- 1 Ramamurtham.S and Narayanan. R “*Fluid Hydraulics and Fluid Machines*” Dhanpat Rai Publishing House (P) Ltd. New Delhi, 2000.
- 2 Streeter, Victor L, and Wylie, E. Benjamin “*Fluid Mechanics*” McGraw Hill Ltd.1998.
- 3 Natarajan.M.K. *Fluid Machines*” Anuradha Agencies, Vidyal Karuppur, Kumbakonaam, 1995

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** To appreciate concepts of conservation of mass, conservation of energy, and the laws of thermodynamics.
- CO2:** To determine the thermodynamic properties of simple compressible substances
- CO3:** To recognize the type of fluid flow that is occurring in a particular physical system
- CO4:** To choose the appropriate fluid mechanic principles needed to analyze fluid-flow situations
- CO5:** To conduct the performance study of pumps and turbines

**COURSE ARTICULATION MATRIX:**

	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	H	H	H	H	M	H	M	H	M	M	L	M	H	M	M
CO2	H	H	H	M	M	M	M	L	M	L	L	M	M	H	M
CO3	H	H	M	H	M	M	L	L	M	L	M	M	H	M	M
CO4	M	H	H	M	M	L	M	H	M	M	L	M	M	M	M
CO5	H	M	M	H	M	L	L	M	M	L	M	M	H	M	M
16NES302	H	H	M	M	M	M	M	M	M	L	L	M	M	M	M

**L- Low, M-Moderate (Medium), H-High**

**16NES303**

**CIRCUITS AND NETWORKS**

**CATEGORY: ES**

**Pre- Requisite :Nil**

L	T	P	C
2	2	0	3

**COURSE OBJECTIVE**

- \* To illustrate the basics of circuits and analysis.
- \* To interpret and analyse the circuits and find the unknowns of the circuit using theorems.
- \* To investigate the DC circuits using time domain analysis.
- \* To evaluate the concepts of impedance and admittance and frequency response.
- \* To transform and reconstruct T and pi network

**UNIT - I : CIRCUIT ANALYSIS**

**(6+6)**

Voltage, Current, Power and Energy – Circuit Elements (R,L,C) – Independent and Dependent Sources – Kirchhoff's Laws – Series and Parallel Combinations of Elements– Voltage Division and Current Division– Node Analysis – Mesh Analysis–Three Phase Networks– Star/Delta Connection.

**UNIT - II : NETWORK THEOREMS**

**(6+6)**

Linearity– Superposition Theorem – Source Transformations–Thevenin's Theorem– Norton's Theorem– Maximum Power Transfer Theorem– Compensation Theorem– Reciprocity Theorem– Millman's theorem–Telegen's Theorem.

**UNIT - III : DC CIRCUITS STEADY-STATE ANALYSIS**

**(6+6)**

Singularity Functions– RC and RL Source-Free Circuits– Constant and Non- Constant Forcing Functions – Initial and Final Values – RLC Circuits– Time-Domain Analysis.

**UNIT - IV : SINUSOIDAL STEADY-STATE ANALYSIS**

**(6+6)**

Sinusoids– Complex Numbers– Complex, Exponential Representations of Sinusoids– Impedance and Admittance– Analysis and Network Theorems for Sinusoidal Steady-State– Frequency Response– Resonance– Power Analysis– Instantaneous and Average Power– Power Factor and Power Factor Correction–Complex Power.

**UNIT - V : TWO PORT NETWORKS**

**(6+6)**

Introduction– T-to-  $\Pi$  Transformation– Two- Port Introduction to Three Terminal Networks– Equations of Two-Port Networks– Z and Y Parameters– Hybrid and Transmission Parameters– Relationships Between Two-Port Parameters– Inter-connection of Two-Port Networks– Lattice Networks.

**CONTACT PERIODS**

Lecture : 30 Periods      Tutorial : 30 Periods      Practical : Nil      Total : 60 Periods

**Text Books :**

- 1 M.E.VanValkenburg "*Network Analysis*" Prentice-Hall, Third Edition, 1974.
- 2 Vasudev. K, Aatre "*Network Theory and Filter Design*" John Wiley & Sons, Second Edition, 1987
- 3 Sudhakar. A , Shyammohan S.Palli"*Circuits and Networks Analysis and Synthesis*" Tata McGraw-Hill Publishing Company Limited, Third Edition,2008.

## Reference Books:

- 1 Boylsted, R.L “*Essentials of Circuit Analysis*” Prentice Hall, 2003.
- 2 William Hayt, Jack.E.Kemmerley and Steven. M. Durbin “*Engineering circuit Analysis*” Tata McGraw-Hill, Sixth Edition, Reprint, 2008
- 3 Alexander, C.K., Matthew, N.O., and Sadiku, “*Fundamentals of Electric Circuits*” Tata McGraw-Hill, 2003
- 4 Joseph. A, Edminister “*Theory and Problems of Electric Circuits*”, Schaum’s Outline Series, McGraw-Hill Book Company, Fourth Edition, 2003
- 5 Richard. C, Dorf& James. A, Svoboda “*Introduction to Electric Circuits*” John Wiley& Sons, Eighth Edition, 2010

## COURSE OUTCOME:

Upon completion of the course, the student will be able

- CO1:** To learn the analysis of circuits using mesh current and nodal voltage methods.
- CO2:** To analyze circuits using network theorems.
- CO3:** To get an insight into solution of RLC circuits.
- CO4:** To understand the concept of complex frequency & free and forced responses of RL, RC & RLC circuits.
- CO5:** To evaluate the different parameters and terminologies of two port networks.

## COURSE ARTICULATION MATRIX:

CO	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	M	M	L	L	L	L	L	L	L	L	L	M	H	M	L
CO2	M	M	L	M	M	L	L	L	L	L	M	L	H	M	M
CO3	L	L	L	M	L	L	L	L	M	L	L	M	H	M	M
CO4	L	H	L	H	M	L	L	L	M	L	M	L	H	M	M
CO5	L	L	L	M	M	L	L	L	L	L	M	L	H	M	H
16NES303	L	M	L	M	M	L	L	L	L	L	M	L	H	M	M

**L- Low, M-Moderate (Medium), H-High**



<b>Pre- Requisite : Nil</b>	L	T	P	C
	3	0	0	3

**COURSE OBJECTIVE**

- \* To familiarize the commonly used number systems, and Boolean algebra.
- \* To explain the basic combinational circuits and their realization using multiplexers.
- \* To illustrate the types of registers and counter.
- \* To facilitate the analysis and design concepts of asynchronous sequential circuits.
- \* To teach the different memory devices.

**UNIT - I : NUMBER SYSTEM AND BOOLEAN ALGEBRA 9**

Review of number systems: Binary, octal, decimal and hexadecimal – types and conversions. Binary code: weighted and non-weighted, error detecting and correcting, sequential, self-complementary, cyclic, reflective codes. Boolean Algebra: Axioms, laws and theorems, logic gates. Switching functions: Minimization and implementation using K-map method and Quine-McCluskey method.

**UNIT – II : COMBINATIONAL CIRCUITS 9**

Design of combinational circuits: Adder, Subtractor, multiplier, code converters, comparator, encoder, decoder, multiplexer, demultiplexer. Function realization using basic gates and multiplexers.

**UNIT – III : SYNCHRONOUS SEQUENTIAL CIRCUITS 9**

Flip Flops: SR, JK, D, T and their conversions. Shift Registers: SISO, SIPO, PIPO, PISO and universal shift registers. Counters: Up, Down, Up-down, mod, ring and Johnson counters. Design and Analysis of circuits using finite state model: serial adder, sequence detector, parity generator, counter.

**UNIT – IV : ASYNCHRONOUS SEQUENTIAL CIRCUITS AND ALGORITHMIC STATE MACHINE 9**

Counter: Up, Down, Up-down. Design and Analysis of fundamental mode circuits. Algorithmic state machine: ASM chart, data path subsystem, Control subsystem – design examples: Binary multiplier, weighing machine.

**UNIT – V : MEMORY DEVICES, PROGRAMMABLE LOGIC DEVICES AND LOGIC FAMILIES 9**

Memory devices: ROM, RAM, PROM, EPROM. Programmable Logic Devices: ROM, PAL, PLA, PROM. Logic Families: TTL, ECL, CMOS. Introduction to VLSI.

**CONTACT PERIODS**

Lecture : 45 periods                  Tutorial : Nil                  Practical : Nil                  Total : 45 periods

**Text books :**

- 1 Donald P Leach and Albert Paul Malvino “*Digital Principles and Applications*” Tata McGraw Hill Education Private Limited, New Delhi, Seventh Edition, 2011
- 2 Thomas L Floyd “*Digital Fundamentals*” Pearson Education International, Eleventh Edition, 2015.

**Reference books:**

- 1 Ronald J Tocci, Neal S Widmer, Gregory L Moss “*Digital Systems: Principles and Applications*” Pearson Education International ,Eleventh Edition, 2010
- 2 Morris Mano M, Michael D Ciletti “*Digital Design with an Introduction to Verilog HDL*” Pearson Education International, Fifth Edition, 2013
- 3 James Palmer, David Perlman “*Introduction to Digital Systems*”, Schaum’s Outline Series McGraw Hill, 2004.
- 4 NPTEL Lecture

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1 :** Perceive the working of digital systems
- CO2 :** Analyse simple digital circuits and effectively communicate the results
- CO3 :** Design synchronous and asynchronous circuits for basic applications and simulate using software tools
- CO4 :** Work as a team and implement simple and safe circuits based on application
- CO5 :** Choose memory devices for use in multidisciplinary projects

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	M	M	L	L	L	L	L	L	L	H	M	M	M
CO2	H	H	H	H	H	M	L	L	M	H	L	M	L	M	M
CO3	H	H	H	M	H	H	M	M	M	M	M	M	L	M	M
CO4	H	M	M	M	H	H	M	H	H	H	M	M	M	M	M
CO5	H	M	M	H	L	H	M	H	M	M	H	L	M	M	L
16NPC304	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M

**L- Low, M-Moderate (Medium), H-High**

16NPC305

SENSORS AND TRANSDUCERS

CATEGORY : PC

Pre- Requisite : Nil

L	T	P	C
3	0	0	3

### COURSE OBJECTIVES

- \* To elaborate the purpose of measurement, various types of transducers and its characteristics.
- \* To explain the various measuring sensors and transducers, their working principle, classification and characteristics.
- \* To teach identification of sensors for different applications and also design signal conditioning circuits.

### UNIT – I : SCIENCE OF MEASUREMENT (09)

Basic concept and terminology of measurement systems – classification of transducer – selection of transducer – general input – output configuration – UNITS and standards – Statistical analysis – calibration. Static and Dynamic characteristics of Transducers.

### UNIT – II : RESISTIVE TRANSDUCERS (09)

Principle, Operation, Characteristics and Applications of Potentiometer – Strain gauge – Load cell - Piezoresistive sensor. Applications – Load and Torque measurement.

### UNIT – III : INDUCTIVE AND CAPACITIVE TRANSDUCERS (09)

Induction Potentiometer – LVDT - Eddy current transducers - Proximity Sensor – Capacitive transducer – Tachogenerators – Stroboscope- Principle , Operation, Characteristics and Applications.

### UNIT – IV : VIBRATION TRANSDUCERS (09)

Piezoelectric transducers and their signal conditioning, photo electric transducers, Hall effect sensors, Magnetostrictive sensor. Basics of Gyroscope, seismic instrument and accelerometers.

### UNIT – V : OTHER TRANSDUCERS (09)

Digital Transducer - Fibre optic sensor – MEMS – Nano sensors – Smart Sensors - Principle, Operation, Characteristics and Applications.

### CONTACT PERIODS

Lecture : 45 periods                      Tutorial : Nil                      Practical : Nil                      Total : 45 periods

### Text books:

- 1 John P. Bentley “*Principles of Measurement Systems*” Pearson Education, 4<sup>th</sup> Edition, 2004.
- 2 E.O. Doebelin and D.N. Manik “*Measurement Systems – Applications and Design*” Tata McGraw Hill, 6<sup>th</sup> Edition, 2012.

### Reference Books:

- 1 Bela G Liptak, “*Instrument Engineers' Handbook, - Process Measurement and Analysis Volume 1*”, CRC Press, 4 Edition, 2003.
- 2 Ian R Sinclair, “*Sensors and Transducers*” Newnes, 3rd Edition, 2001
- 3 D. Patranabis, “*Sensors and Transducers*” Prentice Hall of India, 2nd Edition 2010
- 4 D.V.S. Murthy, “*Transducers and Instrumentation*” Prentice Hall of India, 2nd Edition, 2010.
- 5 A.K. Sawhney, “*A Course in Electrical and Electronics Measurements and Instrumentation*” Dhanpat Rai & Sons, 20<sup>th</sup> Edition, 2013.

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Define UNITS and standards, their conversion and error analysis.
- CO2:** Describe the purpose of measurement system, its classification and characteristics
- CO3:** Explain the principle, operation and characteristics of various transducers.
- CO4:** Design the signal conditioning circuits for various measurements
- CO5:** Select appropriate transducer for simple applications.

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO2	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO3	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO4	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO5	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
16NPC305	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L

**L- Low, M-Moderate (Medium), H-High**



**16NPC306                      ELECTRONIC DEVICES AND CIRCUITS                      CATEGORY : PC**

<b>Pre- Requisite : Nil</b>	L	T	P	C
	4	0	0	4

**COURSE OBJECTIVES**

- \* To familiarize the concepts of semiconductor devices.
- \* To explain the working of transistor in different configurations.
- \* To illustrate the types of field effect transistors.
- \* To facilitate the analysis and design concepts of multistage amplifiers.
- \* To teach the different feedback amplifiers and multivibrator.

**UNIT – I : PN JUNCTION DIODE AND SPECIAL SEMICONDUCTOR DEVICES                      12**

Introduction to semiconductors: chemical bonding, effect of temperature, drifts current, diffusion current, electrical properties. PN junction diode: working, characteristics, diode equation, applications as clipper, clamper, rectifier. Special devices: Basic construction, working and applications of Zener diode, Tunnel diode, Varactor diode, Schottky diode, UJT, SCR, DIAC, TRIAC.

**UNIT – II : BIPOLAR JUNCTION TRANSISTORS                      12**

BJT: Operation, characteristics, biasing, h parameters, and small signal analysis of CB, CE, CC configurations, Transistor as a switch and an amplifier.

**UNIT – III : FIELD EFFECT TRANSISTORS                      12**

JFET: Operation, characteristics, and biasing of CS, CD, CG configurations. FET as an amplifier and a VVR. MOSFET: Operation, characteristics of MOSFET in depletion mode and Enhancement mode.

**UNIT – IV : MULTI STAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER                      12**

Multi stage amplifiers: RC coupling, Transformer coupling and direct coupling, Darlington amplifiers. Differential Amplifier: operation, common mode and difference mode gains, CMRR, AC and DC analysis.

**UNIT – V : FEEDBACK AMPLIFIERS AND MULTIVIBRATORS                      12**

Negative Feedback amplifiers: Operation of voltage and current sampling, series and shunt mixing amplifiers using BJT. Positive Feedback amplifiers: Operation and derivation for frequency of oscillation of RC phase shift, Wein bridge, Hartley, Colpitt and Crystal oscillators. Multivibrators: Operation of Bistable, Monostable and Astable multivibrators using BJT.

**CONTACT PERIODS**

Lecture : 60 periods                      Tutorial : Nil                      Practical : Nil                      Total : 60 periods

**Text books :**

- 1 Robert Boylestad, Louis Nashelsky "*Electronics Devices and Circuit Theory*" Prentice Hall of India, Eleventh Edition, 2015
- 2 Jacob Millman, Christos C Halkias, Satyabrata "*Electronic Devices and Circuits*" McGraw Hill, Second Edition, 2008.

**Reference Books:**

- 1 David A Bell “*Electronic Devices and Circuits*” Oxford Higher Education, Fifth Edition, 2008.
- 2 Thomas L Floyd “*Electronic Devices*” Pearson Education, Ninth Edition, 2012
- 3 Albert Malvino, David J Bates “*Electronic Principles*” McGraw Hill. Seventh Edition, 2006.
- 4 Allen Mottershead “*Electronic Devices and Circuits: An Introduction*” Prentice Hal of India, First Edition, 2011.
- 5 NPTEL Lecture

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1 :** Perceive the working of semiconductor devices
- CO2 :** Analyse multistage amplifier circuits and communicate the results effectively
- CO3 :** Design feedback amplifiers and simulate them using software tools
- CO4 :** Implement circuits using transistors and contribute effectively in a multidisciplinary project
- CO5 :** Choose semiconductor devices based on applications

**COURSE ARTICULATION MATRIX:**

CO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	
<b>CO1</b>	H	H	H	H	L	L	L	L	M	L	L	H	M	M	M	
<b>CO2</b>	H	H	H	H	H	M	L	M	H	H	L	H	M	M	M	
<b>CO3</b>	H	H	H	M	H	H	H	M	H	H	M	H	M	M	M	
<b>CO4</b>	H	M	M	M	H	H	H	H	H	H	H	M	M	M	M	
<b>CO5</b>	H	M	M	M	L	H	H	H	M	M	H	L	M	M	M	
<b>16NPC306</b>	H	H	H	M	M	M	M	M	M	H	M	H	M	M	M	

**L- Low, M-Moderate (Medium), H-High**

**16NES307****THERMAL ENGINEERING AND FLUID  
MECHANICS LABORATORY****CATEGORY: ES****Pre- Requisite : NIL**

L	T	P	C
0	0	4	2

**COURSE OBJECTIVES**

- \* To draw the valve and port timing diagrams of I.C engine.
- \* To estimate the speed of engine by various instruments.

**SECTION A: THERMAL ENGINEERING****LIST OF EXPERIMENTS**

1. Valve timing and Port timing diagrams for I.C. engines.
2. Engine performance evaluation using DC generator as loading device.
3. Performance evaluation using Rope Brake dynamometer.
4. Performance evaluation of engine using Swinging field dynamometer.
5. Estimation of frictional power by fuel consumption measurement and verification by retardation test.
6. Estimation of economical load and economical speed of engine.
7. Test on reciprocating air compressor.
8. Test on constant speed air blower.
9. Fan laws verification on variable speed air blower.

**SECTION B: FLUID MECHANICS**

1. Determination of Darcy's friction factor.
2. Calibration of Flow Meters – Venture meter and Orifice meter.
3. Performance of Rotodynamic pumps.
4. Performance of positive displacement pumps.
5. Performance of Jet pumps.
6. Load test on Pelton Wheel turbine, Kaplan turbine
7. Verification of Bernoulli's theorem.

**CONTACT PERIODS**

Lecture :Nil

Tutorial : Nil

Practical : 60 periods

Total : 60 periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able

- CO1 :** To evaluate the performance of engine using dynamometer.
- CO2 :** To estimate the power and speed of engine by suitable methods.
- CO3 :** To perform operations of different types of pumps
- CO4 :** To calibrate the flow meter using proper designs

**COURSE ARTICULATION MATRIX:**

CO	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
<b>CO1</b>	H	H	H	H	M	L	M	L	M	M	M	M	H	M	M
<b>CO2</b>	H	H	H	H	M	L	M	L	M	M	M	M	H	M	M
<b>CO3</b>	H	H	H	H	M	L	M	L	M	M	M	M	H	M	M
<b>CO4</b>	H	H	H	H	M	L	M	L	M	M	M	M	H	M	M
<b>16NES307</b>	H	H	H	H	M	L	M	L	M	M	M	M	H	M	M

**L- Low, M-Moderate (Medium), H-High**

16NPC308

**ELECTRIC CIRCUITS AND ELECTRONIC DEVICES LABORATORY**

**CATEGORY: PC**

**Pre- Requisite : Nil**

L	T	P	C
0	0	4	2

**COURSE OBJECTIVES**

- \* To familiarize the laws and theorems used in electric circuit.
- \* To explain the characteristics of semiconductor devices.
- \* To facilitate the design of electronic circuits

**LIST OF EXPERIMENTS**

1. Experimental verification of Kirchoff’s laws
  2. Experimental verification of Superposition, Thevenin and Norton’s theorems.
  3. Frequency Response of RL, RC and RLC circuits
  4. Design of High pass and Low pass filters
  5. Characteristics of PN Junction diode and Zener diode
  6. Characteristics of Transistor in CB, CE and CC modes
  7. Characteristics of FET, UJT
  8. Characteristics of SCR, TRIAC and DIAC
  9. Design of amplifier circuits
  10. Design of oscillators
  11. Design of Multi-vibrator
  12. Design of differential amplifiers
- (The above experiments may be also done using simulation tools)

**CONTACT PERIODS**

Lecture :Nil                                      Tutorial : Nil                                      Practical : 60 periods                                      Total : 60 periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1 :** Perceive the working of electric circuits and electronic devices.
- CO2 :** Analyse the frequency responses and characteristics of semiconductor devices and effectively communicate the results
- CO3 :** Design electronic circuits for basic applications and simulate using software tools
- CO4 :** Work as a team and implement simple and safe circuits based on application
- CO5 :** Choose appropriate device for use in multidisciplinary projects

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	H	H	L	L	L	L	H	L	H	M	M	M	M
CO2	H	H	H	H	H	L	H	M	H	H	H	M	M	M	M
CO3	H	H	H	H	H	H	H	H	H	H	H	M	M	M	M
CO4	H	H	M	H	H	H	H	H	H	H	H	M	M	M	M
CO5	H	M	M	M	L	M	H	M	H	H	M	M	M	M	M
16NPC308	H	M	M	H	H	M	H	M	H	H	H	M	M	M	M

**L- Low, M-Moderate (Medium), H-High**



16NBS401

**PROBABILITY,RANDOM PROCESSES AND  
QUEUEING THEORY**

(common to EIE, CSE & IT branches)

**CATEGORY: BS**

L	T	P	C
3	2	0	4

**COURSE OBJECTIVES**

- To gain the knowledge of basics of probability.
- To familiarize with standard distributions both discrete and continuous cases and problems of two dimensional distributions.
- To obtain the knowledge of Random process and Markov chains.
- To acquire knowledge of queuing models with finite/infinite capacity in single/ multi servers.

**UNIT - I : PROBABILITY AND RANDOM VARIABLES 9+6**

Axioms of probability-Conditional probability-Total probability-Bayes' theorem-Random variables-Discrete and continuous random variables-Moments- Moment generating functions and their properties.

**UNIT - II : STANDARD DISTRIBUTIONS 9+6**

Binomial ,Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions and their properties- Functions of Random variable.

**UNIT - III : TWO DIMENSIONAL RANDOM VARIABLES 9+6**

Joint distributions-Marginal Distributions-Conditional distributions-Covariance-Correlation and Regression-Transformation of random variables-Central Limit theorem.

**UNIT - IV : RANDOM PROCESSES AND MARKOV CHAINS 9+6**

Definition and Examples-first and second order, strictly stationary, wide sense stationary and ergodic processes-Markov process-Poisson processes-Birth and Death processes-Markov chains-Transition probabilities-Limiting distributions.

**UNIT - V : QUEUEING THEORY 9+6**

Markovian models- M/M/1 and M/M/c, finite and infinite capacity, M/G/1 queue (steady state solutions only) Pollazack Khintchine formula-special cases.

**CONTACT PERIODS:**

Lecture : 45 periods      Tutorial : 30 periods      Practical : Nil      Total : 75 periods

**Text Books:**

1. Veerarajan T "*Probability and Random Processes (with Queueing Theory and Queueing Networks)*" McGraw Hill Education(India) Pvt Ltd., New Delhi, Fourth Edition 2016.

**Reference Books:**

1. Gupta S.P "*Statistical Methods*" Sultan Chand & Sons, New Delhi, 2015.
2. Kandasamy, Thilagavathy and Gunavathy "*Probability and Random Process*" S. Chand & Co, Ramnagar, New Delhi, Reprint 2013.
3. Gupta S.C and Kapoor V.K "*Fundamentals of Mathematical Statistics*" Sultan Chand & Sons, New Delhi, 2015.
4. Trivedi K.S "*Probability and Statistics with Reliability, Queuing and Computer Science Applications*" Prentice Hall of India, New Delhi. 2013.

**COURSE OUTCOMES:**

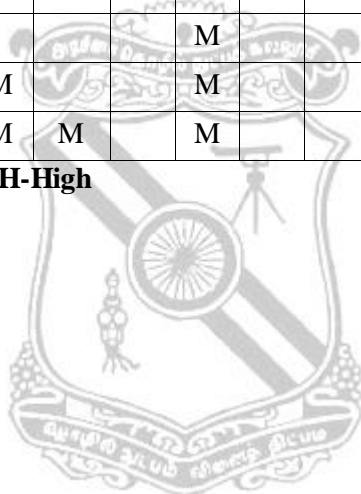
Upon completion of the course, the student will be able to

- CO1:** Understand the concepts of probability and random variables.
- CO2:** Understand the distributions of discrete and continuous random variables.
- CO3:** Understand marginal and conditional probability densities under two Dimensional distributions.
- CO4:** Understand the first and second order stationary process and probabilities of Markovian processes.
- CO5:** Understand queuing models.

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	M	M						H			H	L	M
CO2	H	H	M		M					H			H	M	M
CO3	H	H	M				L			H			H	L	M
CO4	H	H	H				M			M	M		H	L	M
CO5	H	H	H	M			M			H	H		H	L	M
16NBS401	H	H	M	M	M		M			H	M		H	L	M

**L- Low, M-Moderate (Medium), H-High**



**16NPC402**

**LINEAR INTEGRATED CIRCUITS**

**CATEGORY: PC**

**Pre- Requisite**

			L	T	P	C
1	16NPC306	ELECTRONIC DEVICES AND CIRCUITS	3	0	0	3

**COURSE OBJECTIVES**

- \* To familiarize the working of operational amplifier.
- \* To explain the basic applications of operational amplifier.
- \* To illustrate various wave form generators.
- \* To facilitate the analysis and design concepts of multistage amplifiers.
- \* To teach the different A-D and D-A converters.

**UNIT - I : OPERATIONAL AMPLIFIER CHARACTERISTICS**

**9**

Functional block diagram and operation of Op-amp, DC Characteristics: Input bias current, input offset current, input offset voltage and thermal drift, AC Characteristics: Frequency response, stability, frequency compensation, slew rate.

**UNIT - II : APPLICATIONS OF OP-AMPS**

**9**

Basic operation of 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.

**UNIT - III : COMPARATORS AND WAVEFORM GENERATORS**

**9**

Basic operation and applications of comparator, Schmitt trigger, astable and monostable multi-vibrators, triangular wave generators.

**UNIT - IV : VOLTAGE REGULATORS AND TIMERS**

**9**

Voltage Regulators: 723 General purpose regulator, switching regulator. 555 Timers: Functional block diagram, mono stable and astable operation and applications. VCO, PLL and its applications.

**UNIT - V : D-A AND A – D CONVERTERS**

**9**

D-A converter: Weighted resistor, R-2R ladder, and inverted R-2R types. A – D converter: Flash, counter, servo tracking, successive approximation, dual slope types. DAC and ADC performance characteristics.

**CONTACT PERIODS**

Lecture : 45 periods                      Tutorial : Nil                      Practical : Nil                      Total : 45 periods

**Text Books :**

- 1 Ramkant A Gayakwad, “*Op-Amps and Linear Integrated Circuits*” Prentice Hall of India, Fourth Edition, 2009.
- 2 Robert F Coughlin, Frederick F Driscoll, “*Operational amplifiers and Integrated Circuits*” Prentice Hall of India, 2009

**Reference Books:**

- 1 William D Stanely, “*Operational Amplifiers with Linear Integrated Circuits*” Pearson Education, Fourth Edition, 2009.
- 2 Albert Malvino, David Bates, “*Electronic Principles*” Tata McGraw Hill, Seventh Edition, 2008.
- 3 NPTEL Lecture

**COURSE OUTCOMES:**

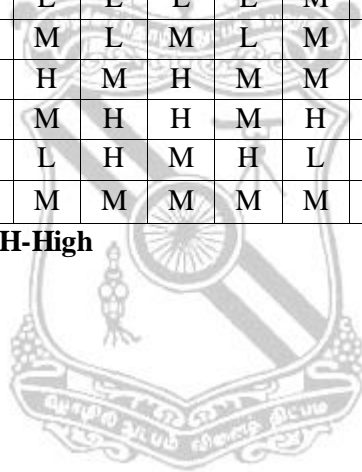
Upon completion of the course, the student will be able to

- CO1:** Perceive the working of operational amplifier
- CO2:** Analyse operational amplifier circuits and communicate the results effectively
- CO3:** Design circuits using operational amplifier and simulate them using software tools
- CO4:** Work effectively in a team and implement circuits using operational amplifier
- CO5:** Choose converters based on applications

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	H	H	L	L	L	L	M	L	L	H	M	M	M
CO2	H	H	H	H	M	L	M	L	M	H	L	M	M	M	M
CO3	H	M	H	M	H	M	H	M	M	M	H	H	M	M	M
CO4	H	M	M	M	M	H	H	M	H	M	H	H	M	M	M
CO5	H	M	M	H	L	H	M	H	L	M	M	M	M	M	M
16NPC402	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M

**L- Low, M-Moderate (Medium), H-High**



16NPC403

SIGNALS AND LINEAR SYSTEMS

CATEGORY: PC

**Pre- Requisite**

1 16NBS3Z1

ENGINEERING MATHEMATICS III

L	T	P	C
3	2	0	4

**COURSE OBJECTIVES**

- \* To describe the fundamental characteristics of signals and systems.
- \* To familiarize signals and systems in terms of both the time and transform domains, taking advantage of the complementary insights and tools that these different perspectives provide.
- \* To facilitate the mathematical skills to solve problems involving filtering, modulation and sampling.

**UNIT - I : INTRODUCTION TO CONTINUOUS TIME SIGNALS (CT) AND SYSTEMS**

9+6

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

**UNIT - II : ANALYSIS OF CT SIGNALS AND SYSTEMS**

9+6

Time domain analysis:—solutions of differential equation. Fourier series and Fourier transform analysis of signals, spectrum of CT signals, Laplace Transform analysis of signals and systems, Analysis of random signals.

**UNIT - III : DISCRETIZATION AND SIGNAL RECONSTRUCTION**

9+6

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 SIGNALS**

9+6

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+6

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

**CONTACT PERIODS**

Lecture : 45 periods

Tutorial : 30 periods

Practical : Nil

Total : 75 periods

**Text Books :**

- 1 Tarun Kumar Rawat “**Signals and Systems**” Oxford University Press,2010
- 2 Proakis,J.G.,& Manolakis, D.G., “**Digital Signal Processing: Principles and Algorithms, & Applications**”, 3/e Prentice Hall of India, 2007.

## Reference Books:

- 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
- 5
  - [www.nptel.ac.in/courses/117104074/](http://www.nptel.ac.in/courses/117104074/)
  - <https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/download-resource-materials/>

## COURSE OUTCOMES:

Upon completion of the course, the student will be able to

- CO1:** Understand the fundamental characteristics of signals and systems.
- CO2:** Analyze the spectral characteristics of continuous-time periodic and a periodic signals using Fourier analysis.
- CO3:** Classify systems based on their properties and determine the response of LSI system using convolution.
- CO4:** Apply the Laplace transform and Z- transform for analyze of continuous-time and discrete-time signals and systems.
- CO5:** Understand the process of sampling and the effects of under sampling.

## COURSE ARTICULATION MARTIX:

CO	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	H	H	M	M	L	M	L	L	M	M	H	H	H	L	M
CO2	H	H	H	M	M	L	L	M	M	M	M	M	H	M	M
CO3	H	M	M	H	M	L	L	L	M	M	M	M	H	L	M
CO4	H	H	H	H	M	M	L	L	M	M	L	M	H	M	M
CO5	H	M	M	M	M	L	L	L	M	M	M	H	H	M	H
16NPC403	H	H	H	M	M	L	L	L	M	M	M	M	H	M	M

**L- Low, M-Moderate (Medium), H-High**



**Reference Books:**

- 1 Cooper, W.D. and Helfric, A.D. “*Electronic Instrumentation and Measurements*” Prentice Hall of India, 2<sup>nd</sup> Edition, 2008.
- 2 Bouwens A.J. “*Digital Instrumentation*” Mcgraw Hill, 2001.
- 3 Martin U. Reissland “*Electrical Measurement*” New age international (P) Ltd, 2010
- 4 A.K. Sawhney, Puneet Sawhney “*A Course in Electronic and Electrical Measurements and Instrumentation*” S.K.Kataria & Sons, Delhi, 2012
- 5 Sanjay Gupta and Joseph John “*Virtual Instrumentation using LabVIEW*” Tata-McGraw Hill, 2<sup>nd</sup> Edition, 2010

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Explain the principle and operation of instruments used for the measurement of voltage and current, power and energy instruments, waveform analyzers and signal instruments
- CO2:** Design suitable bridges used for the measurement of resistance and impedance.
- CO3:** Identify and analyze the possibility of errors and their compensation.
- CO4:** Analyze the range, pros and cons of different instruments.
- CO5:** Suggest suitable type of instruments for various measurements.

**COURSE ARTICULATION MARTIX:**

CO	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	H	H	M	M	L	L	L	H	L	M	L	L	H	M	L
CO2	H	H	H	H	L	L	L	H	L	M	L	L	H	M	L
CO3	H	H	H	H	L	L	M	H	L	M	L	L	H	M	L
CO4	H	H	H	H	L	L	L	H	L	M	L	L	H	M	L
CO5	H	H	H	H	M	L	L	H	L	M	L	L	H	M	L
16NPC404	H	H	H	H	L	L	L	H	L	M	L	L	H	M	L

**L- Low, M-Moderate (Medium), H-High**



**16NES405**

**ELECTRICAL DRIVES**  
(Qualitative Treatment Only)

CATEGORY: ES

**Pre- Requisite : Nil**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

- \* To impart the knowledge on energy conversion and generation of DC and AC power.
- \* To impart the knowledge on testing of electrical machines and identify their suitability for real time application.

**UNIT - I : DC MACHINES**

**9**

Principle of operation - construction – EMF and torque equation – Characteristics of different types of DC generators and motors – starting, and speed control characteristics of dc motors.

**UNIT - II : TRANSFORMERS**

**9**

Principle of operation – Types and general features of construction of single phase and three phase transformers –EMF equation- Phasor diagrams – Equivalent circuit – Regulation and efficiency – Autotransformers.

**UNIT - III : INDUCTION MACHINES**

**9**

Constructional features of three phase Induction motors – Principle of Operation – torque-slip characteristics – starting, and speed control methods – solid state control– Principle of operation and types of single phase Induction motors.

**UNIT - IV : SYNCHRONOUS MACHINES**

**9**

Types and general constructional features – EMF equation – regulation – power angle curve – phasor diagram of synchronous motor – starting methods.

**UNIT - V : DRIVES AND SPECIAL MOTORS**

**9**

Types of electrical drives – factors influencing the choice of electrical drives- loading conditions and classes of duty- determination of power rating.

Principle of operation of Universal motor – Reluctance and Hysteresis motor – Stepper motors –Switched reluctance motor- Linear Induction motor – BLDC.

**CONTACT PERIODS**

Lecture : 45 periods      Tutorial : Nil      Practical : Nil      Total : 45 periods

**Text Books:**

- 1 Kothari D.P. and Nagrath I.J “**Electric Machines**” Tata McGraw Hill, Fourth Edition, 2011
- 2 Theraja B.L. and Theraja A.K “**A Text Book of Electrical Technology- Vol. II**”, S.Chand and Co. Ltd., New Delhi, 2007
- 3 Pillai S.K “ **A First Course on Electrical Drives** “ New Age International Publishers, New Delhi,2010

**Reference Books:**

- 1 Fitzgerald A.E., Kingsly C. and Kusko A. “*Electric Machinery*” Tata McGraw Hill, 2007
- 2 Irving.L.Kosow, “*Electrical Machinery and Transformers*” PHI, 2<sup>nd</sup> Edition, 2007.
- 3 Stephen J Chapman “*Electric Machinery*” Tata McGraw Hill, Fourth Edition 2005
- 4 Sen.S.K, “*Electric Drives*” PHI,2009.
- 5 Vedam Subramaniam “*Electric Drives- Concepts and Applications*” TMH,2011

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Illustrate the construction, working, characteristics and applications of AC and DC machines.
- CO2:** Evaluate the performance characteristics of electrical machines for the different level of utilization in industries
- CO3:** Apply the concepts of static and dynamic electrical machines and the principles of electromagnetism
- CO4:** Control the parameters in electrical machines and identify their suitability for real time application
- CO5:** Select the appropriate drives and special motors for industrial applications.

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	M	M	L	M	H	L	H	M	H	M	H	L	M
CO2	H	H	M	H	M	L	H	M	H	H	H	M	H	M	M
CO3	H	H	H	H	M	M	M	M	H	H	M	H	H	M	H
CO4	H	H	M	H	M	M	M	M	H	H	M	H	H	M	H
CO5	H	M	M	M	L	M	M	M	M	M	H	M	H	L	M
16NES405	H	H	M	M	M	M	M	M	H	H	M	M	H	M	M

**L- Low, M-Moderate (Medium), H-High**

**16NES406****ELECTRICAL MACHINES AND DRIVES****CATEGORY: ES****LABORATORY****Pre-Requisite: Nil**

L	T	P	C
0	0	4	2

**COURSE OBJECTIVES**

\* To give hands-on-training on static and dynamic electromechanical energy conversion mechanics by conducting various tests and study their performance characteristics.

**LIST OF EXPERIMENTS**

1. Swinburne's test.
2. Open circuit characteristics and load test on D.C. shunt generator.
3. Open circuit characteristics and load test on D.C. compound generator.
4. Open circuit characteristics and load test on separately excited D.C. generator.
5. Load test on D.C. shunt motor.
6. Load test on D.C. series motor.
7. Load test on D.C. compound motor.
8. Speed control of D.C. shunt motor.
9. OC and SC tests on single phase transformer.
10. Load test on single phase transformer.
11. Separation of losses in transformer.
12. Three phase transformer connections.
13. Load test on three phase induction motor.
14. Equivalent circuit of three phase induction motor.
15. Regulation of three phase alternator by EMF method

**CONTACT PERIODS**

Lecture : Nil                      Tutorial : Nil                      Practical : 60 periods                      Total :60 periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1 :** Obtain the characteristics of generators and transformers.  
**CO2 :** To find the parameters of DC machines and the transformers  
**CO3 :** To control motor, induction machines, alternators and transformers.  
**CO4 :** To determine the parameters of synchronous and induction machines  
**CO5 :** To calculate the loss occurred in transformers.

**COURSE ARTICULATION MARTIX:**

CO	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	H	H	H	H	L	L	L	L	L	L	L	H	M	M	M
CO2	H	H	H	H	L	L	L	L	L	L	M	H	M	M	M
CO3	H	H	H	H	H	M	M	M	H	L	M	H	M	M	M
CO4	H	H	H	H	H	M	M	M	H	H	M	H	M	M	M
CO5	H	M	M	M	L	H	M	H	M	H	M	H	M	M	M
16NES406	H	H	H	H	M	M	M	M	M	M	M	H	M	M	M

**L- Low, M-Moderate (Medium), H-High**

**16NPC407****LINEAR AND DIGITAL CIRCUITS  
LABORATORY****CATEGORY: PC****Pre- Requisite**

- |   |          |                                     |
|---|----------|-------------------------------------|
| 1 | 16NPC402 | LINEAR INTEGRATED CIRCUITS          |
| 2 | 16NPC304 | DIGITAL PRINCIPLES AND APPLICATIONS |

L	T	P	C
0	0	4	2

**COURSE OBJECTIVES**

- To familiarize different analog and digital ICs,.
- To explain the applications of Op-Amps and logic gates.
- To facilitate the design of Op-Amp circuits and digital circuits

**LIST OF EXPERIMENTS**

1. Verification of logic gates and realization of Boolean expressions using gates.
2. Study and verification of flip-flops
3. Design of decoder, encoder, multiplexer and de-multiplexer circuits
4. Design of comparators, parity checkers and generators
5. Design of shift registers
6. Design of counters
7. Applications of Op-Amp Circuits using resistive feedbacks.
8. Design of voltage and current regulators
9. Design of Instrumentation amplifier
10. Design of Op-Amp filters
11. Applications of 555 Timer
12. Study of phase lock loop

*(The above experiments may be also done using simulation tools)*

**CONTACT PERIODS**

Lecture : Nil                      Tutorial : Nil                      Practical : 60 periods                      Total : 60 periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1 :** Perceive the working of Op-Amps and logic gates.
- CO2 :** Analyse and debug circuits and rectify the errors
- CO3 :** Design electronic circuits for basic applications and simulate using software tools
- CO4 :** Work as a team and implement simple and safe circuits based on application
- CO5 :** Choose appropriate ICs for use in multidisciplinary projects

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	H	H	L	L	L	L	L	L	L	H	M	M	M
CO2	H	H	H	H	L	L	L	L	L	L	M	H	M	M	M
CO3	H	H	H	H	H	M	M	M	H	L	M	H	M	M	M
CO4	H	H	H	H	H	M	M	M	H	H	M	H	M	M	M
CO5	H	M	M	M	L	H	M	H	M	H	M	H	M	M	M
16NPC407	H	H	H	H	M	M	M	M	M	M	M	H	M	M	M

**L- Low, M-Moderate (Medium), H-High**

**16NPC408****SENSORS AND MEASUREMENTS  
LABORATORY****CATEGORY: PC****Pre- Requisite**

1 16NPC305 SENSORS AND TRANSDUCERS

L	T	P	C
0	0	4	2

**COURSE OBJECTIVES**

- \* To make the students aware of basic concepts of measurement and operation of different types of transducers.

**LIST OF EXPERIMENTS**

1. Characteristics of Thermocouple and LDR
2. Characteristics of RTD and Thermistor
3. Characteristics of linear displacement transducers (LVDT )
4. Photoelectric Transducer
5. Characteristics of strain gauge and load cell
6. Capacitive Transducer
7. Loading effect of Potentiometer
8. Digital Transducer – shaft angle encoder
9. Pressure Transducer
10. Wheatstone and Kelvin’s bridge for measurement of resistance.
11. Schering Bridge for capacitance measurement
12. Anderson Bridge for inductance measurement
13. Maxwell’s inductance bridge

**CONTACT PERIODS**

Lecture : nil

Tutorial : nil

Practical : 60 periods

Total : 60 periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Understand the characteristics of different types of transducers.
- CO2:** Gain knowledge about the different types of bridges for measurement of resistance, capacitance and inductance.
- CO3:** Interpret the results and draw meaningful conclusions in a written report.
- CO4:** Work as a member of a team while carrying out experiments.
- CO5:** Develop generic skills in project management, project documentation and reporting.

**COURSE ARTICULATION MATRIX:**

CO	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	H	L	L	L	L	L	L	L	L	L	L	L	H	L	L
CO2	H	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO3	L	L	L	H	L	L	L	L	L	H	L	L	L	L	L
CO4	L	L	L	L	L	L	L	L	H	L	L	L	L	L	L
CO5	L	L	L	L	L	L	L	L	L	L	H	L	L	H	L
16NPC408	L	L	L	L	L	L	L	L	L	L	L	H	L	H	H

**L- Low, M-Moderate (Medium), H-High**

16NPC501

CONTROL SYSTEMS

CATEGORY: PC

L	T	P	C
3	2	0	4

Pre- Requisite

- 1 16NBS2Z2 Engineering Mathematics II
- 2 16NBS3Z1 Engineering Mathematics III

COURSE OBJECTIVES

- To teach the fundamental concepts of Control systems and mathematical modelling of the system
- To study the concept of time response and frequency response of the system
- To teach the basics of stability analysis of the system
- To demonstrate and discuss the characteristics of PID controller, stepper motor, synchros and mathematical model of systems using State Space analysis.

UNIT - I: TRANSFER FUNCTIONS

9+6 Periods

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

UNIT – II: TRANSIENT AND STEADY STATE ANALYSIS

9+6 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: TIME AND FREQUENCY DOMAIN ANALYSIS

9+6 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.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+6 Periods

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

UNIT - V: CONTROL SYSTEM COMPONENTS AND STATE SPACE ANALYSIS

9+6 Periods

Potentiometer – Error detector –Synchros – Stepper motors –Tacho generators- PID controllers – Servo motors. State model – Introduction – Solution of state model – State transition matrix – Controllability and Observability.

Contact Periods:

Lecture : 45 Periods      Tutorial : 30 Periods      Practical : Nil      Total : 75 Periods

Text Books:

- 1 Benjamin C.Kuo “*Automatic Control Systems*” PHI Learning Private Ltd, 2010
- 2 I.J. Nagarath and M.Gopal “*Control Systems Engineering*” Fourth Edition, New Age International (P) Ltd., Publishers, 2005
- 3 Norman S. Nise “*Control System Engineering*” John wiley & Sons, 6th edition, 2006

**Reference Books:**

- 1 M.Gopal “*Control Systems Principles and Design*” Tata McGraw-Hill, 2008
- 2 Katsuhiko Ogata “*Modern Control Engineering*” Pearson Education, New Delhi, 5<sup>th</sup> Ed. 2010
- 3 Richard C. Dorf and Robert H. Bishop “*Modern Control Systems*” Pearson Education Pvt. Ltd., New Delhi, 4<sup>th</sup> Edition, 2010.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Find the transfer function for linear, time-invariant mechanical and electrical systems using differential equations.
- CO2:** Use poles and zeros of transfer functions to determine the time and frequency response of a control system
- CO3:** Comment on stability of a transfer function and analyse using frequency domain plots
- CO4:** Design compensators using frequency domain plots
- CO5:** Understand the working principle of control system components and acquire Knowledge of state space analysis and to define controllability and observability.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	M	L	M	M	L	L	M	M	M	M	M	L	L
CO2	M	M	M	M	H	M	M	M	L	L	L	L	M	H	H
CO3	L	L	M	M	M	M	M	M	M	M	M	M	L	M	M
CO4	L	H	H	H	H	H	H	H	H	M	H	L	L	H	M
CO5	L	L	M	M	M	M	M	L	L	L	L	L	L	L	M
16NPC501	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M

**L- Low, M-Moderate (Medium), H-High**

## 16NPC502 PRINCIPLES OF COMMUNICATION SYSTEMS CATEGORY: PC

Pre- Requisite			L	T	P	C
1	16NPC402	Linear Integrated Circuits	3	0	0	3

### COURSE OBJECTIVES

- \* To explain the fundamental concepts involved in amplitude, frequency, phase modulation and digital communication techniques and the various transmitters and receivers involved with it.
- \* To illustrate the need for transmission medium and the various transmission medium used for transmission.
- \* To detail out the basics of microwave and satellite communication techniques.

### UNIT - I : AMPLITUDE MODULATION 9

Need for modulation - AM – Frequency Spectrum - Power relation - Generation of AM -Collector modulated class C amplifier - Balanced modulators – Principle of SSB and VSB transmission – AM Detection - Envelope Detector - AM Transmitters - Low level and High level transmitters – AM Receivers – TRF receiver, super heterodyne receiver

### UNIT - II : FREQUENCY MODULATION 9

Introduction to angle modulation systems – Definition of FM and PM – Narrow band and Wide band FM – FM Modulators – Direct and Indirect method – FM Demodulators – Slope detector – Foster Sealy Discriminator – FM Transmitters and Receivers – Comparison of AM and FM

### UNIT - III : DIGITAL COMMUNICATION 9

Pulse modulation systems- Quantization – Sampling theorem – Principles of PAM, PWM and PPM – Principles of ASK, FSK and PSK – Applications of Data Communication – Time Division Multiplexing – Frequency Division Multiplexing.

### UNIT - IV : TRANSMISSION MEDIUM 9

Transmission lines – types, equivalent circuit, losses, standing waves, impedance matching, bandwidth, radio propagation – ground wave, sky and space waves.

### UNIT - V : MICROWAVE AND SATELLITE COMMUNICATION 9

Microwave frequencies – microwave systems – Simplified Microwave system block diagram- Repeaters – Need for diversity – Frequency and Space diversity - Orbital Satellites – Geostationary Satellites – Look angles – Satellite System link models – Satellite System link equations

### Contact Periods:

Lecture : 45 Periods                      Tutorial : nil                      Practical : nil                      Total : 45 Periods

### Text Books :

- 1 Wayne Tomasi “Electronic Communication Systems” Pearson Education, 6<sup>th</sup> Edition, 2008.
- 2 George Kennedy, Brendan Davis, SRM Prasanna, “Electronic Communication Systems” McGraw Hill, 5<sup>th</sup> Edition, 2011.
- 3 Anoke Singh “Principles of Communication Engineering” S.Chand & CO., 2006.



**Reference Books:**

- 1 Herbert Taub, Donald Schilling, Goutam Saha “*Principles of Digital Communication*” Tata McGraw Hill, 4<sup>th</sup> edition 2013
- 2 Terman “*Electronic and Radio Engineering*” McGraw Hill, 1994.
- 3 Simon Haykin, Michael Moher “*Communication Systems*” Wiley India Pvt. Ltd, 4<sup>th</sup> Edition, 2009
- 4 Roy Blake “*Electronic Communication Systems*” Thomson Delmar, 2<sup>nd</sup> Edition , 2012

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Define the concept of modulation, understand its need and the generation of analog modulation techniques
- CO2:** Describe the various transmitters and receivers used for analog modulation.
- CO3:** Understand and define sampling, quantization and elaborate the digital communication techniques
- CO4:** Explore the transmission medium used for communication and the losses associated with it.
- CO5:** Define the basic principles and operation of microwave and satellite communication techniques.

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO2	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO3	H	H	M	M	L	L	M	H	L	M	L	L	H	L	L
CO4	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO5	H	H	M	M	M	L	L	H	L	M	L	L	H	L	L
16NPC502	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L

**L- Low, M-Moderate (Medium), H-High**

**16NPC503                      INDUSTRIAL INSTRUMENTATION I                      CATEGORY: PC**

<b>Pre- Requisite</b>			<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	16NPC305	Sensors and Transducers	3	0	0	3

**COURSE OBJECTIVES**

- \* To provide the knowledge about various techniques used for the measurement of industrial parameters.
- \* To have an adequate knowledge about temperature and pressure transducers.
- \* To explore the various measuring techniques for force, torque, speed, acceleration, vibration, density, viscosity, humidity and moisture.

**UNIT - I : MEASUREMENT OF FORCE, TORQUE AND SPEED                      9**

Different types of load cells: Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells - Different methods of torque measurement: Strain gauge, Relative angular twist. Speed measurement: Capacitive and Drag cup type tacho, D.C and A.C tacho generators – Stroboscope.

**UNIT - II : MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY                      9**

Accelerometers: LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers - Mechanical type vibration instruments - Seismic instruments as accelerometer – Vibration sensor - Calibration of vibration pickups - UNIT -s of density and specific gravity – Baume scale and API scale – Densitometers: Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.

**UNIT - III : PRESSURE MEASUREMENT                      9**

UNIT -s of pressure – Manometers-Types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules - Electrical methods: Elastic elements with LVDT and strain gauges - Capacitive type pressure gauge – Piezo-resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum: McLeod gauge, Thermal conductivity gauge, ionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester.

**UNIT - IV : MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE                      9**

Viscosity: Saybolt viscometer - Rotameter type and Torque type viscometers – Consistency Meters – Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell – Commercial type dew meter. Moisture: Different methods of moisture measurements –Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement - Moisture measurement in solids.

**UNIT - V : TEMPERATURE MEASUREMENT                      9**

Definitions and standards – Different types of filled in system thermometer – Bimetallic thermometers – Thermocouples: Laws of thermocouple, Fabrication of industrial thermocouples, Reference junctions compensation, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Response of thermocouple, Radiation fundamentals - Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Two colour radiation pyrometers – Fibre optic sensor for temperature measurement.

**Contact Periods:**

Lecture : 45 Periods                      Tutorial : Nil                      Practical : Nil                      Total : 45 Periods

**Text Books :**

1. Doebellin.E.O. and Manik D.N “*Measurement systems Application and Design*” 5<sup>th</sup> Edition, Tata McGraw-Hill Education Pvt. Ltd, 2007.
2. Patranabis. D “*Principles of Industrial Instrumentation*” 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010

**Reference Books:**

- 1 Liptak.B.G “*Instrumentation Engineers Handbook*” CRC Press, 2005.
2. Jones.B.E “*Instrument Technology*” Vol.2, Butterworth-Heinemann, International Edition, 2003
3. Eckman D.P “*Industrial Instrumentation*” Wiley Eastern Limited, 1990.
4. Singh,S.K “*Industrial Instrumentation and Control*” Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi, 2009.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Explain the construction and working of instruments used for measurement of force, torque, speed, acceleration, vibration, density, viscosity, humidity, moisture, temperature and pressure.
- CO2:** Select the instruments according to the application.
- CO3:** Compare the advantages and disadvantages of measuring devices and importance of calibration with procedure of calibration pertaining to various measurements.
- CO4:** Design signal conditioning circuits and compensation schemes for temperature measuring instruments.
- CO5:** Engage in research activities carried out in industries and manage projects.

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
CO2	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
CO3	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
CO4	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
CO5	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
16NPC503	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H

**L- Low, M-Moderate (Medium), H-High**



**Reference Books:**

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D.McKinlay “*The 8051Microcontroller and Embedded Systems*” 2<sup>nd</sup> Edition 2008, 5<sup>th</sup> Reprint, 2010,Pearson Education.
- 2 . Krishna Kant “*Microprocessor and Microcontroller Architecture,programming and system design using 8085, 8086, 8051, 8096*” PHI, 7<sup>th</sup> Reprint 2011.
3. Ray, A.K. and Bhurchandi, K.M., “*Advanced Microprocessor and Peripherals*” 2<sup>nd</sup> Edition, Tata McGraw-Hill, 2007.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Understand the architecture of any advanced Processor to keep in pace with technological challenges.
- CO2:** Create structured, well-commented, understandable programs in assembly language.
- CO3:** Interface various devices to microprocessor and microcontroller.
- CO4:** Apply the acquired Programming skills and relate to any Processor/microcontroller in a multidisciplinary project.
- CO5:** Develop/design microcontroller based system paving way for automation and Continuous development.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	L	M	M	M	H	H	H	M	M	H	M	M	H
CO2	H	M	L	M	M	M	M	M	H	M	H	M	H	M	M
CO3	H	M	L	M	H	M	M	H	H	H	M	H	H	M	H
CO4	H	M	L	L	M	M	M	M	H	M	M	M	H	M	M
CO5	H	H	H	H	M	M	M	H	H	M	M	M	H	M	M
16NPC504	H	M	L	M	M	M	M	M	H	M	M	M	H	M	M

**L- Low, M-Moderate (Medium), H-High**

**16NPC505 INDUSTRIAL HYDRAULICS AND PNEUMATICS CATEGORY: PC**

**Pre- Requisite**

L	T	P	C
3	0	0	3

1. 16NES302 Thermal Engineering and Fluid Mechanics

**COURSE OBJECTIVES**

\* To provide exposure to the basics of hydraulic and pneumatic principles and development of circuits for various engineering applications.

**UNIT - I : FLUID POWER PRINCIPLES 9**

Introduction to fluid power – Advantages and Applications – Fluid power systems – Types of fluids – Properties of fluids -Fluid power symbols – Basic of Hydraulics: Pascal’s Law, Principles of flow, work, Power and Torque. Applications of Pascal’s Law-Losses in pipe, valves and fittings.

**UNIT - II : HYDRAULIC SYSTEM AND COMPONENTS 9**

Pumping Theory – Pump Classification – Fixed and Variable displacement Pumps: Working, Advantages, Disadvantages and Performances. Hydraulic Actuators: Cylinders, Types and Construction Hydraulic motors – Performance charts. Direction control, flow control and pressure control valves – Types, Applications Accessories – Accumulator and Intensifiers.

**UNIT - III : CONTROL OF HYDRAULIC SYSTEMS 9**

Reciprocating- sequencing – synchronizing – regenerative – pump unloading – double pump circuits – Counterbalance valve application circuit - Accumulators circuits - Intensifier circuits - Fail-safe circuits- Hydrostatic Transmission.

**UNIT - IV : PNEUMATIC SYSTEMS 9**

Compressors – Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators – Introduction to Fluidics – Pneumatic logic circuits AND,OR, MEMORY, etc.

**UNIT - V : ELECTRO HYDRAULIC AND ELECTRO-PNEUMATIC CIRCUITS 9**

Sequential circuits – design for simple applications using cascade method – Electro Pneumatic circuits –fluid power circuits-Low cost Automation – Hydraulic and Pneumatic Power Packs – Installation, Fault finding and Maintenance.

**Contact Periods:**

Lecture : 45 Periods                      Tutorial : Nil                      Practical : Nil                      Total : 45 Periods

**Text Books :**

1. Anthony Esposito “*Fluid Power with Applications*”, 7<sup>th</sup> edition, Pearson education, 2014.
2. Andrew Parr “*Hydraulics & Pneumatics*” Jaico Publishing House, 2004.
3. Majumdar “*Pneumatic system: Principles and Maintenance*” Tata McGraw Hill, 2004

**Reference Books:**

1. William W. Reaves, “*Technology of Fluid Power*”,. Delmer Publishers, 1997
2. Petor Rohner, “*Fluid power logic circuit Design*” Macmillon Press Ltd, 1990.
3. Harry L. Stevart D.B “*Practical guide to fluid power*” Taraoeala sons and Port Ltd. ,Broadey, 1976.
- 4 Michael J, Prinches and Ashby J. G, “*Power Hydraulics*” Prentice Hall, 1989.
5. Dudelyt, A. Pease John T. Pippenger “*Basic Fluid Power*” Prentice Hall, 1987

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1 Identify fluid power systems and select the appropriate pumps for industrial applications.
- CO2 Demonstrate the applicability of hydraulic power systems for engineering applications.
- CO3 Design customized circuits in hydraulics for various industrial needs.
- CO4 Choose pneumatic systems and demonstrate the applicability of pneumatic power systems on real life applications.
- CO5 Apply the standard maintenance procedures of fluid power and pneumatic systems

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	L	M	M	M	M	L	M	M	M	M	H	M	M
CO2	M	M	H	H	M	L	L	L	M	M	M	M	M	H	M
CO3	H	H	H	M	M	L	L	L	M	M	L	M	H	M	M
CO4	M	M	H	M	H	M	M	L	M	M	M	H	M	H	M
CO5	H	H	H	M	H	H	M	M	M	M	M	M	H	M	M
16NPC505	M	M	H	M	M	M	M	L	M	M	M	M	M	M	M

**L- Low, M-Moderate (Medium), H-High**



**Pre- Requisite**

1 16NPC501 Control Systems

L	T	P	C
0	0	4	2

**COURSE OBJECTIVES**

- \* To evaluate the basic parameters of open loop and closed loop systems.
- \* To interpret the transient response and steady state response of the systems.
- \* To design a controller or compensator to meet the given desired specifications.

**LIST OF EXPERIMENTS**

1. Open loop and closed loop position control system
2. Open loop and closed loop speed control system.
3. Digital position control system.
4. Simulation of first order system with dead time.
5. Simulation of second order system with dead time
6. Transfer function of field controlled DC motor.
7. Transfer function of armature controlled DC motor.
8. Transfer function of separately excited dc generator.
9. System Analysis using MATLAB.
10. Design and Simulation of PI and PID controllers for a first and second order system.
11. Design and Simulation of LAG, LEAD compensators.

**Contact Periods:**

Lecture : Nil

Tutorial : Nil

Practical : 45 Periods

Total : 45 Periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Find the transfer function for linear, time-invariant systems.
- CO2:** Use poles and zeros of transfer functions to determine the time response for linear, time-invariant translational and rotational mechanical systems.
- CO3:** Use poles and zeros of transfer functions to determine the frequency response for linear, time-invariant translational and rotational mechanical systems.
- CO4:** Analyse the gain effects in a system when PID controllers are employed.
- CO5:** Utilize frequency response techniques in the design of compensators to meet the desired requirements.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	H	H	H	L	M	H	H	H	H	M	H	H	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	M	H	H	H	L	M	H	H	H	H	M	H	H	H
CO4	M	M	H	H	H	L	M	H	H	H	H	M	H	H	H
CO5	M	M	H	H	H	L	M	H	H	H	H	M	H	H	H
16NPC507	M	M	H	H	H	L	M	H	H	H	H	M	H	H	H

**L-Low, M-Moderate (Medium), H-High**



**16NPC508****MICROPROCESSORS AND  
MICROCONTROLLERS LABORATORY****CATEGORY: PC****Pre- Requisite**

1 16NPC504 MICROPROCESSORS AND MICROCONTROLLERS

L T P C

0 0 4 2

**COURSE OBJECTIVES**

- \* To introduce to students the basics of microprocessor and microcontroller Programming and their applications.

**LIST OF EXPERIMENTS**

- Programming using Arithmetic, Logical instructions of 8085 microprocessor.
- Programming using String manipulation instructions of 8085 microprocessor.
- Programming using Arithmetic, Logical and Bit manipulation instructions of 8051 microcontroller .
- Programming using arithmetic, logical, string instructions of 8086.
- Interfacing ADC/DAC/ stepper motor with  $\mu\text{p}$  /  $\mu\text{c}$ .
- Data transfer between computer and  $\mu\text{p}$  /  $\mu\text{c}$ .
- Interfacing with Keypad (4 x 4) with  $\mu\text{p}$  /  $\mu\text{c}$ .
- I<sup>2</sup>C based RTC/ EEPROM/ 7-Segment display Interface with  $\mu\text{p}$  /  $\mu\text{c}$ .
- Interfacing of limit Switches/ Push buttons/ Solenoid valves/ Pumps.

**Contact Periods:**

Lecture : Nil                      Tutorial : Nil                      Practical : 45 Periods                      Total : 45 Periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Exploit the features/instruction of the microprocessor and microcontroller to develop microprocessor/microcontroller based system.
- CO2:** Provide automation solutions to the real-time processes and thereby improving the efficiency.
- CO3:** Facilitate interdisciplinary projects based on the acquired programming skills.
- CO4:** Present the results in oral form as well as in written form as a report
- CO5:** Interpret the results and draw meaningful conclusions.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	H	H	H	L	M	H	H	H	H	M	H	H	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	M	H	H	H	L	M	H	H	H	H	M	H	H	H
CO4	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO5	M	M	H	H	H	L	M	H	H	H	H	M	H	H	H
16NPC508	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H

**L- Low, M-Moderate (Medium), H-High**

**16NPC601**

**INDUSTRIAL INSTRUMENTATION II**

**CATEGORY: PC**

L T P C

3 0 0 3

**Pre- Requisite**

- 1 16NPC305 Sensors and Transducers
- 2 16NPC503 Industrial Instrumentation I

**COURSE OBJECTIVES**

- \* To provide sound knowledge about various measurement techniques used for the measurement of industrial parameters
- \* To get an adequate knowledge about industrial safety environment.
- \* To study about various flow and level sensors.

**UNIT – I : VARIABLE HEAD TYPE FLOW METERS**

**9**

Expression for flow rate through restriction (compressible and incompressible flow) – Orifice plate – different types of orifice plates – Venturi tube – Flow nozzle – Dall tube – Elbow taps – Pitot tube – installation and applications of head flow meters.

**UNIT – II : QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS**

**9**

Positive displacement flow meters: Nutating disc, Reciprocating piston and Oval gear flow meters – Inferential meter: Turbine flow meter – Variable Area flow meter: Rota meter theory, characteristics, installation and applications – Mass flow meter: Angular momentum, Thermal and Coriolis type mass flow meters – Calibration of flow meters: Dynamic weighing method.

**UNIT – III : ELECTRICAL TYPE FLOW METERS**

**9**

Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Target flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.

**UNIT - IV : LEVEL MEASUREMENT**

**9**

Level measurement: Float type – Displacer type – Hydrostatic type – thermal effect types – Electrical methods - Rotating paddle switches - Load cell – Conductivity sensors – Nucleonic gauge – ultrasonic sensors – Boiler drum level measurement: Differential pressure and Hydra step methods – Solid level measurement, level sensor selection and application.

**UNIT - V : HAZARD AND SAFETY**

**9**

Introduction to electrical hazards, hazardous areas and classification, nonhazardous areas, enclosures- NEMA types, fuses and circuit breakers. Purging, explosion proofing and intrinsic safety, Prevention of ignition, Methods of protection.

**Contact Periods:**

Lecture : 45 Periods      Tutorial : Nil      Practical : Nil      Total : 45 Periods

**Text Books:**

1. Doebellin.E.O. and Manik D.N “*Measurement systems” Application and Design* ” 5<sup>th</sup> Edition, Tata McGraw-Hill Education Pvt. Ltd., 2007.
2. Patranabis. D “*Principles of Industrial Instrumentation* ” 3<sup>rd</sup> Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010.

**Reference Books:**

1. Liptak, B.G. *“Instrumentation Engineers Handbook (Measurement)”* CRC Press, 2005
2. Jain, R.K. *“Mechanical and Industrial Measurements”* Khanna Publishers, Delhi, 1999.
3. Singh, S.K. *“Industrial Instrumentation and Control”* Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2009.
4. Douglas M. Considine, *“Process / Industrial Instruments and Controls Handbook”* 5th Edition, McGraw Hill, Singapore, 1999.

**COURSE OUTCOME:**

Upon successful completion of the course the student will be able to

- CO1:** Describe the constructional details and theory of operation of different variable head type flow meters.
- CO2:** Understand the construction, working and calibration of different quantity flow meters, variable area flow meters, mass flow meters, electrical type, open channel and solid flow meters.
- CO3:** Choose the proper flow and level measuring instruments for appropriate applications.
- CO4:** Gain knowledge about the hazards in industrial area and apply the safety methods to avoid any dangerous situation.
- CO5:** Engage in research activities carried out in industries and manage projects.

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
CO2	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
CO3	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
CO4	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
CO5	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H
16NPC601	H	M	M	M	L	H	M	M	H	M	H	H	H	L	H

**L- Low, M-Moderate (Medium), H-High**

**16NPC602**

**PROCESS CONTROL**

**CATEGORY: PC**

**Pre- Requisite**

			L	T	P	C
1	16NPC503	Industrial Instrumentation I	3	0	0	3
2	16NPC501	Control systems				

**COURSE OBJECTIVES**

- \* To introduce the terminology and concepts of modelling in the process.
- \* To explain the basic modes of controller.
- \* To illustrate the different methods of tuning of controllers.
- \* To familiarize the pneumatic and electric actuators used in process industries
- \* To teach the basics of advanced control systems.

**UNIT - I : PROCESS CONTROL SYSTEM 9**

Terms and objectives, piping and instrumentation diagram, instrument terms and symbols. Regulatory and Servo control, classification of variables. Process characteristics: process equation, degrees of freedom, modelling of simple systems – thermal, gas and liquid systems. Process lag, load disturbance and their effects on processes. Self-regulating processes, interacting and non-interacting processes.

**UNIT - II : CONTROLLER MODES 9**

Basic control action, two position, multi position, floating mode control. Continuous controller modes: proportional, integral, derivative. Composite controller modes: P-I, P-D, P-I-D, Integral wind-up and prevention. Auto/Manual transfer, Bumpless transfer. Response of controllers for different test inputs. Selection of control modes for processes like level, pressure, temperature and flow.

**UNIT - III : CONTROLLER TUNING METHODS 9**

Evaluation criteria - IAE, ISE, ITAE. Process reaction curve method, continuous oscillation method, damped oscillation method. Auto tuning. Closed loop response of I & II order systems, with and without valve, measuring element dynamics.

**UNIT - IV : FINAL CONTROL ELEMENTS 9**

Pneumatic and electrical actuators, Valve positioners. Pneumatic and electrical dampers, Control valves types, construction details and various plug characteristics. Valve sizing. Selection of control valves. Inherent and installed valve characteristics. Fail-safe operation, Cavitation and flashing in control valves, Instrument air supply specifications.

**UNIT - V : ADVANCED PROCESS CONTROL SYSTEM 9**

Cascade control, ratio control, feed forward control. Over-ride, split range and selective control. Multivariable process control, interaction of control loops. Case Studies: Distillation column, boiler drum level control and chemical reactor control.

**Contact Periods:**

Lecture : 45 Periods      Tutorial : Nil      Practical : Nil      Total : 45 Periods

**Text Books :**

1. Bequette, B.W “*Process Control Modeling, Design and Simulation*”, Prentice Hall of India, 2004.
2. Seborg, D.E, Edgar. T.F and Mellichamp. D.A, “*Process Dynamics and Control*”, Wiley John and Sons, Second Edition, 2003.

**Reference Books:**

1. G.Stephanopoulos “*Chemical Process Control-An Introduction to Theory and Practice*” Prentice Hall of India, New Delhi, Second Edition, 2005.
2. Johnson .C.D “*Process Control Instrument Technology*” Prentice Hall of India, 2004
3. D.R. Coughanowr “*Process Systems Analysis and Control*” McGraw Hill, Singapore, Second Edition, 1991.
4. C.L.Smith and A.B Corripio “*Principles and Practice of Automatic Process Control*” John Wiley and Sons, New York, Second Edition 1998.

**COURSE OUTCOMES:**

Upon successful completion of the course the student will be able to

- CO1:** Mathematically model processes based on first principles
- CO2:** Analyse the responses of various systems when subjected to different modes of control and report them effectively
- CO3:** Choose appropriate controllers based on process dynamics.
- CO4:** Select appropriate final control elements for processes
- CO5:** Design and Implement controllers based on the applications.

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	H	M	L	L	L	L	M	L	M	H	M	M	M
CO2	H	H	M	H	L	L	L	L	M	H	M	M	M	M	M
CO3	H	H	M	M	L	M	M	M	M	M	M	M	M	M	M
CO4	H	H	M	M	L	M	M	M	M	M	M	M	M	M	M
CO5	H	H	H	H	M	M	M	M	H	L	M	H	M	M	M
16NPC602	H	H	M	M	L	M	M	M	M	M	M	M	M	M	M

**L- Low, M-Moderate (Medium), H-High**

16NPC603

DISCRETE TIME SIGNAL PROCESSING

CATEGORY: PC

**Pre- Requisite**

1 16NPC403 Signals and Linear Systems

L	T	P	C
3	2	0	4

**COURSE OBJECTIVES**

- \* To impart the concepts of convolution and DTFT techniques.
- \* To teach the realization structures of FIR and IIR filters
- \* To introduce DSP processor and FFT processors.

**UNIT - I : DIGITAL PROCESSING**

**9+6 Periods**

Block diagram, advantages and applications, Linear and circular convolution, convolution techniques for long duration sequence, autocorrelation and cross correlation, aliasing effects in time domain – Review of DTFS, DTFT and Z-Transform.

**UNIT - II : DISCRETE TIME FOURIER TRANSFORM**

**9+6 Periods**

Discrete time Fourier series and its convergence, discrete time Fourier Transform, its properties, frequency response. Introduction to radix -2 DFT- decimation in time (DIT) FFT – decimation in frequency (DIF) FFT- IDFT using DFT.

**UNIT - III : FIR FILTERS**

**9+6 Periods**

Ideal digital filters, Reliability and filter specifications, Classification of linear phase FIR filters, Design using direct truncation, window methods and frequency sampling, Least-squares optimal FIR filters, Minimal optimal FIR filters, Design of digital differentiators and Hilbert transformers, comparison of design methods.

**UNIT - IV : IIR FILTERS**

**9+6 Periods**

Introduction to Infinite Impulse Response filter, Butterworth, Chebyshev approximation. - Design of analog prototype filters, Analog frequency transformations, Impulse invariance method and digital frequency transformations, Bi-linear transformation, Analog prototype to digital transformations, Difficulties in direct IIR filter design, Comparisons with FIR filters.

**UNIT - V : DSP PROCESSORS**

**9+6 Periods**

Computer architectures for signal processing – Harvard architecture and pipelining, interrupts. Addressing modes and programming of DSP processors. Special purpose hardware – hardware digital filters and hardware FFT processors, Evaluation boards for real-time DSP- realization of PID controller using DSP processors.

**Contact Periods:**

Lecture : 45 Periods      Tutorial : 30 Periods      Practical : Nil      Total : 75 Periods

**Text Books :**

1. Proakis, J.G., & Manolakis, D.G., “*Digital Signal Processing: Principles and Algorithms, & Applications*” 3/e Prentice Hall of India, 2007.
2. Chen, C.T. “*Digital Signal Processing: Spectral Computation & Filter Design*” Oxford Univ. Press, 2001

**Reference Books:**

1. McClellan, J.H., Schafer, R.W., & Yoder, M.A. “*DSP First: A Multimedia Approach*” 2/e, Prentice Hall Upper Saddle River, NJ, 2003.
2. Mitra, S.K. “*Digital Signal Processing: A Computer-Based Approach*” 4/e, McGraw Hill, NY 2011.
3. Embree, P.M., & Danieli, D “*C++ Algorithms for Digital Signal Processing*” Prentice Hall Upper Saddle River, NJ, 1999.
4. Steven Smith. “*The Scientist and Engineer's Guide to Digital Signal Processing*” California technical publishing, CA,2001
5. www.nptel.ac.in/https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/study-materials/

**COURSE OUTCOMES:**

Upon successful completion of the course the student will be able to

- CO1:** Analyze discrete-time systems in both time & transform domain
- CO2:** Analyze discrete-time signals and systems using DFT and FFT.
- CO3:** Design and implement digital finite impulse response (FIR) filters.
- CO4:** Design and implement digital infinite impulse response (IIR) filters.
- CO5:** Understand and develop multi-rate digital signal processing systems.

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	M	M	L	L	M	M	L	M	M	H	H	M	H
CO2	H	H	M	M	M	M	L	M	M	M	M	M	H	M	M
CO3	H	H	M	M	M	M	L	M	M	M	M	M	H	M	M
CO4	H	H	M	M	M	M	L	M	M	M	M	M	H	M	M
CO5	H	H	M	M	M	M	L	M	M	M	M	M	H	M	M
16NPC603	H	H	M	M	M	M	L	M	M	M	M	M	H	M	M

**L- Low, M-Moderate (Medium), H-High**

**Pre- Requisite**

1 16NPC503 Industrial Instrumentation I

L T P C

3 0 0 3

**COURSE OBJECTIVES**

- \* To impart the knowledge about the working principles of spectrophotometer.
- \* To describe the different gas analyzers, pH meter, dissolved oxygen and pollution monitoring instruments.
- \* To develop an understanding of the working principle, types and applications of NMR spectroscopy, Mass spectroscopy, Gas chromatography and Liquid chromatography.

**UNIT - I : SPECTROPHOTOMETRY****9**

Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometer- FTIR spectrophotometer – Atomic absorption spectrophotometer - Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.

**UNIT - II : CHROMATOGRAPHY****9**

General principles – classification – chromatographic behaviour of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications.

**UNIT - III : INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS****9**

Gas analyzers – Oxygen, NO<sub>2</sub> and H<sub>2</sub>S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases. Measurement of air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide - Dust and smoke measurements.

**UNIT - IV : pH METERS AND DISSOLVED COMPONENT ANALYZERS****9**

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**

NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.

**Contact Periods:**

Lecture : 45 Periods

Tutorial : Nil

Practical : Nil

Total : 45 Periods

**Text Books:**

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



**Reference Books:**

1. Liptak.B.G “*Process Measurement and Analysis*” CRC Press, 5<sup>th</sup> Edition, 2015.
2. Ewing, G.W “*Instrumental Methods of Chemical Analysis*” McGraw-Hill, 5<sup>th</sup> Edition reprint 1985. (Digitized in 2007).
3. Braun. R.D “*Introduction to Instrumental Analysis*” Pharma Book Syndicate, Singapore, 2006.
4. Robert E. Sherman “*Analytical Instrumentation*” Instruments Society of America, 1996

**COURSE OUTCOMES:**

Upon successful completion of the course the student will be able to

- CO1:** Understand the fundamental principles of analytical instruments.
- CO2:** Analyse the strengths and limitations of the various instrumental methods.
- CO3:** Understand the applications and usage of chromatography in real time industrial environments.
- CO4:** Select Instrument for a particular analysis with some idea of its merits, demerits and limitations.
- CO5:** Apply the specific technique employed for monitoring different pollutants in air and water.

**COURSE ARTICULATION MATRIX:**

CO	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	M	H	L	M	M	H	H	H	H	H	H	M	M	M	M
CO2	H	H	M	M	M	M	M	H	H	H	M	M	H	M	M
CO3	H	M	L	M	M	M	M	H	H	M	M	M	H	M	M
CO4	H	H	M	H	M	H	M	H	H	M	M	M	H	M	M
CO5	H	H	M	M	H	H	M	H	H	M	M	M	H	M	M
16NPC604	H	H	M	M	M	M	M	H	H	M	M	M	H	M	M

**L- Low, M-Moderate (Medium), H-High**

16NPC607

PROCESS CONTROL LABORATORY

CATEGORY : PC

Pre Requisite : Nil

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

- \* To familiarize different system dynamics and valve characteristics
- \* To facilitate effective design and tuning of controllers
- \* To explain how advanced controllers respond to system disturbances

LIST OF EXPERIMENTS

1. Study of control valve characteristics
2. Response of different order processes with and without transportation lag
3. Experimental modeling of a flow process
4. Comparison of responses of single, non interacting and interacting processes
5. Comparison of controller responses for a level process
6. Comparison of controller responses for a flow process
7. Comparison of controller responses for a pressure process
8. Comparison of controller responses for a temperature process
9. Cohen Coon method of tuning of controllers
10. Ziegler Nichols method of tuning of controllers
11. Design of feed forward controller using simulation software
12. Design of cascade controller using simulation software

Contact Periods:

Lecture : Nil                      Tutorial : Nil    Practical : 45 Periods                      Total : 45 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

- CO1:** Perceive the working of control valves.
- CO2:** Analyse the performance of controllers for various processes and report them effectively
- CO3:** Design and tune controllers for different processes and simulate using software tools
- CO4:** Work as a team and implement safe control operations of processes
- CO5:** Choose appropriate controllers based on applications

COURSE ARTICULATION MATRIX:

CO	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	H	M	L	L	L	L	L	L	L	L	L	M	H	L	M
CO2	H	H	M	M	H	M	M	M	L	H	L	M	H	H	M
CO3	H	H	H	M	H	M	M	M	M	M	L	M	H	H	M
CO4	H	M	L	L	L	M	M	M	H	M	L	M	H	L	M
CO5	H	M	M	M	L	M	M	M	M	L	M	M	H	L	M
16NPC607	H	M	M	M	M	M	M	M	M	M	L	M	H	M	M

L- Low, M-Moderate (Medium), H-High

**16NPC608****INDUSTRIAL INSTRUMENTATION  
LABORATORY****CATEGORY : PC****Pre Requisite**

1 16NPC503 Industrial instrumentation- I

L T P C  
0 0 4 2**LIST OF EXPERIMENTS**

- Calibration of pressure gauge using Dead weight Tester.
- Measurement of Flow rate - Orifice meter and rotameter.
- Characteristics of I/P and P/I Converters.
- Measurement of Humidity and pH.
- Calibration of Smart Transmitters using HART 375 and 475 Communicator.
- Characteristics of conductivity meter.
- UV, IR Spectrophotometer.
- Viscosity Measurement.
- Measurement of Bio- medical parameters (EEG,EMG,BP)
- Level measurement using DPT (open tank , closed tank)
- Calibration of temperature sensor.

**Contact Periods:**

Lecture : Nil

Tutorial :Nil Practical : 45 Periods

Total : 45 Periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Get an adequate knowledge about selecting particular sensing elements for the measurement of physical parameters.
- CO2:** Analyze the measured value for displaying or controlling the physical variables.
- CO3:** Design a signal conditioning circuit for interfacing sensor with controller.
- CO4:** Demonstrate a working knowledge of safety practices used in the measurement and control of real time processes.
- CO5:** Demonstrate skills in trouble shooting problems with the measurement and control of industrial processes.

**COURSE ARTICULATION MATRIX**

CO	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	H	M	L	M	L	M	M	H	H	H	H	M	H	L	M
CO2	H	H	H	H	M	M	M	H	H	M	M	H	H	M	H
CO3	H	H	H	H	L	M	M	H	H	M	H	M	H	L	M
CO4	M	M	M	M	L	M	M	H	H	M	H	M	M	L	M
CO5	M	M	M	M	L	M	M	H	H	M	H	M	M	L	M
16NPC608	H	M	M	M	L	M	M	H	H	M	H	M	H	L	M

**L- Low, M-Moderate (Medium), H-High**

**16NEE609**

**MINI PROJECT/INDUSTRIAL  
TRAINING/INTERNSHIP**

**CATEGORY : EEC**

L	T	P	C
0	0	4	2

**COURSE OBJECTIVES:**

- \* To use the knowledge acquired in various subjects of Electronics and Instrumentation Engineering and carry out Mini Project. This will motivate students to come up with new designs, Fabrication, Developing algorithms and software programs expressing their ideas in a novel way.
- \* To learn methodology to select a good project and able to work in a team leading to development of hardware/software product.

**MINI PROJECT**

- 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. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs.
- The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The evaluation will be made based on this report and a viva- voce examination, conducted internally by a 3 member committee appointed by Head of the Department.

**INDUSTRIAL TRAINING/INTERNSHIP**

(6 WEEKS – DURING SUMMER VACATION)

The student may undergo Industrial Training /Internship and the credits earned will be indicated in the mark sheet. If the student earns three credits in Industrial Training /Internship, the student may drop one professional Elective. In such cases Industrial Training / internship needs to be undergone continuously from one organization only. The student is allowed to undergo a maximum of 6 weeks Industrial Training /Internship during the entire duration of study.

The Industrial Training/Internship shall carry 100 marks and shall be evaluated through continuous assessment only. The progress of the Industrial Training/Internship is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department At the end of industrial training/Internship; the student shall submit a brief report on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and a viva-voce Examination, Conducted internally by a three member Departmental Committee constituted by the Head of the Department. Certificate (issued by the organization)) submitted by the student shall be attached to the mark list and sent to Controller of Examination by the Head of the Department.

**Contact Periods:**

Lecture : Nil

Tutorial : Nil

Practical : 45 Periods Total : 45 Periods

### **COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Select a good project and able to work in a team leading to development of hardware/software product.
- CO2:** Prepare a good technical report and able to present the ideas with clarity.
- CO3:** Gain Knowledge on various terminologies related to industrial environment.
- CO4:** Work efficiently as a member of different teams related to multidisciplinary projects.
- CO5:** Acquire skills to communicate efficiently and gain management skills related to industry and research organizations.

### **COURSE ARTICULATION MATRIX:**

CO	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	M	M	H	H	M	H	H	H	M	H	H	M	M	M	H
CO2	H	M	H	H	M	M	M	L	M	M	H	M	H	M	M
CO3	H	M	L	M	L	M	M	M	M	M	H	H	H	L	M
CO4	H	H	H	H	M	M	M	L	M	M	H	H	H	M	M
CO5	M	H	H	M	M	M	L	M	M	H	H	H	M	M	H
16NEE609	M	M	H	M	M	M	M	M	M	M	H	H	H	M	M

**L- Low, M-Moderate (Medium), H-High**



**16NHS701 INDUSTRIAL MANAGEMENT AND ECONOMICS CATEGORY: HS**  
(common to EEE)

**Pre- Requisite : NIL**

L T P C  
3 0 0 3

**COURSE OBJECTIVES**

- \* To study the concepts of micro economics
- \* To study the concepts of macro economics
- \* To understand the basic concept of management thought
- \* To study the different functions of management
- \* To study the organizational behaviour

**UNIT - I : MICRO ECONOMICS 9**  
Definition of Economics, Scope; Demand – Curve, Schedule, Factors affecting demand, Elasticity of Demand; Supply – Curve, Factors influencing supply, Elasticity, Supply behaviour in different time Periods

**UNIT - II : MACRO ECONOMICS 9**  
Money – Evolution, Functions: Central Bank and Commercial Banks Functions; Inflation – Definition, Types, Methods of correcting, Impact; Deflation – Definition, Methods of correcting, Impact.

**UNIT - III : BASICS OF MANAGEMENT THOUGHT 9**  
Evolution of Management, Management – Definition, Levels, Principles, Differences with administration, Roles of Managers, Contributions of Henry Fayol, Taylor and Ducker to Management, External environment of business, Social responsibility of business.

**UNIT - IV : FUNCTIONS OF MANAGEMENT 9**  
Planning – Premises, Process, Types of Plans; Organizing – Departmentation, Authority – Responsibility relationship, Span of Management; Staffing – Manpower Planning (Manpower Planning Chart and Process), Staffing (Systems approach to staffing), Directing – Leadership theories, Motivation theories and Communication (Process, Barriers, Guidelines for effective communication).

**UNIT - V : ORGANIZATION BEHAVIOUR 9**  
Individual behaviour – Values (Types, Formation), Personality, Learning; Group behaviour – (Types of groups, Stages of group formation, Reasons for joining groups); Organization culture (Origin, Modes of transmission).

**Contact Periods:**

Lecture : 45 Periods                      Tutorial : Nil                      Practical : Nil                      Total : 45 Periods

**Text Books :**

1. Koontz “*Essentials of Management*” McGraw Hill, 2006
2. Prasad L.M “*Principles and Practice of Management*” Sultan Chand and Sons, 7<sup>th</sup> Edition 2008.
3. Varshney.R.I, Maheshwary K.L “*Managerial Economics*” Sultan Chand and Sons, 2006.

**Reference Books:**

1. Stephen P Robbins “**Organizational Behavior**” Prentice Hall of India, New Delhi, 2007.
2. Samuelson and Nordhaus “**Economics**” McGraw Hill Ltd., 2009

**COURSE OUTCOMES:**

Upon successful completion of the course the student will be able

**CO1:** The concepts of micro economics, macroeconomics.

**CO2:** The basic concept of management thought.

**CO3:** The different functions of management and the organizational behaviour.

**COURSE ARTICULATION MATRIX:**

CO	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	H			H		H	H		H				H		M
CO2	H	H				H	H						H	M	
CO3						H	H							M	M
16NHS701	H	H		H		H	H		H				H	M	M

**L- Low, M-Moderate (Medium), H-High**

16NPC702

**DISTRIBUTED CONTROL SYSTEM AND APPLICATIONS**

**CATEGORY: PC**

**Pre- Requisite : NIL**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

- \* To introduce the concept and programming of programmable logic controllers and distributed control system this is used for process automation.
- \* To elaborate the HART and Fieldbus bus protocols used for communication.
- \* To outline the basic concepts of SCADA technology.

**UNIT - I : PROGRAMMABLE LOGIC CONTROLLER BASICS 9**

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.

**UNIT - II : PROGRAMMING OF PLC 9**

Fundamentals of logic – Program scan – Relay logic – PLC programming languages – Construction of PLC ladder diagram – basic components and their symbols - timers – counters - math instructions – data manipulation instructions – Analog PLC operation – PID Control of continuous process - Sequencer instruction - connecting PLC to computer – Application of PLC – Bottle filling System.

**UNIT - III : SCADA 9**

Introduction - Supervisory Control and Data Acquisition Systems (SCADA) –HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.

**UNIT - IV : DISTRIBUTED CONTROL SYSTEMS 9**

DCS – Various Architectures – Comparison – Local control UNIT - – Process interfacing issues – Communication facilities – Low and High level engineering and operator interfaces- case studies in DCS.

**UNIT - V : HART AND FIELD BUS 9**

Introduction – evolution of signal standards – HART communication protocol – communication modes – HART networks – Control system interface – HART commands – HART field controller implementation – HART and OSI model – Field bus – Introduction – General field bus architecture – basic requirements of field bus standard – field bus topology – interoperability –interchangeability.

**Contact Periods:**

Lecture : 45 Periods                      Tutorial :Nil                      Practical : Nil                      Total : 45 Periods

**Text Books :**

1. John.W. Webb Ronald A Reis “*Programmable Logic Controllers - Principles and Applications*” Prentice Hall Inc., 5<sup>th</sup> Edition, 2003.
2. M. P. Lukcas “*Distributed Control Systems*” Van Nostrand Reinhold Co., 1986.



**Reference Books:**

1. Bela G Liptak, “*Process software and digital networks – Volume 3*” 4<sup>th</sup> Edition, CRC press, 2012.
2. Frank D. Petruzella, “*Programmable Logic Controllers*” 5<sup>th</sup> Edition, McGraw Hill, 2016.
3. Huges T “*Programmable Logic Controllers*” ISA press, 1994.
4. Romily Bowden, “*HART application guide and the OSI communication foundation*”, 1999.
5. Krishna Kant, “*Computer Based Industrial Control*”, Second edition, Prentice Hall of India, New Delhi, 2010

**COURSE OUTCOMES:**

Upon successful completion of the course the student will be able to,

- CO1:** Elaborate the basic architecture, input and output modules in PLC
- CO2:** Construct ladder logic diagram using PLC basic functions, timer and counter functions, advanced functions, sequencer and interlock functions for real time applications
- CO3:** Describe the basics of SCADA technology.
- CO4:** Illustrate the functionary components, redundancy and supervisory control of DCS with relevant diagrams
- CO5:** Integrate the importance of communication protocols in DCS and system integration with PLC

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO2	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO3	H	H	M	M	L	L	M	H	L	M	L	L	H	L	L
CO4	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO5	H	H	M	M	M	L	L	H	L	M	L	L	H	L	L
16NPC702	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L

**L- Low, M-Moderate (Medium), H-High**

**16NEE707 INSTRUMENTATION SYSTEM DESIGN LABORATORY CATEGORY : EEC****PRE REQUISITE : NIL**

L	T	P	C
0	0	4	2

**COURSE OBJECTIVES:**

- \* To provide knowledge base on various signal conditioning circuits.
- \* To demonstrate the design of amplifier circuits for specified applications.

**LIST OF EXPERIMENTS**

1. Design of Instrumentation amplifier.
2. Design of active filters.
3. Design of regulated power supply and design of V/I and I/V converters.
4. Design of Active Low Pass, High Pass, Band Pass and Band Reject Filters.
5. Design of DC Motor Driver Circuit
6. Design of linearization circuits and cold – junction compensation circuit for thermocouples.
7. Design of signal conditioning circuit for strain gauge.
8. Design of signal conditioning circuit for RTD.
9. Design of orifice plate and rotameter.
10. Control valve sizing.
11. Design of PID controller using operational amplifier.
12. Piping and Instrumentation Diagram – case study.

**Contact Periods:**

Lecture : Nil                      Tutorial :Nil                      Practical : 45 Periods                      Total : 45 Periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Get an adequate knowledge about selecting the amplifier circuits for the measurement of physical parameters.
- CO2:** Analyze the measured value for controlling the physical variables.
- CO3:** Design a signal conditioning circuit for interfacing sensor with controller.
- CO4:** Demonstrate a working knowledge of Piping and Instrumentation practices used in real time processes.
- CO5:** Demonstrate skills in trouble shooting problems with the measurement and control of industrial processes.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	H	H	H	L	M	H	H	H	H	M	M	M	H
CO2	M	M	H	H	H	M	L	H	H	M	H	H	H	H	M
CO3	M	M	H	H	H	M	L	H	H	M	H	H	H	H	M
CO4	M	M	H	H	H	M	L	H	H	M	H	H	H	H	M
CO5	M	M	H	H	H	M	L	H	H	M	H	H	H	H	M
16NEE707	M	M	H	H	H	M	L	H	H	M	H	H	H	H	M

**L-Low,M-Moderate(medium), H-High**

**16NEE708****INDUSTRIAL AUTOMATION  
LABORATORY****CATEGORY : EEC****Pre Requisite**

1 16NPC602 Process Control

L T P C

0 0 4 2

**COURSE OBJECTIVES:**

- \* To introduces the practical methods of automatic control of processes and systems.
- \* To learn the PLC programming for various real time process applications.

**LIST OF EXPERIMENTS**

1. Interfacing Level Transmitter and Control Valve with Personal Computer.
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. Simple exercises using the Instruction Set of an Industrial Type PLC.
4. Filling/draining control operation using PLC
5. Reversal of DC motor direction using PLC
6. Traffic light control using PLC
7. Alarm Annunciator Sequence using PLC
8. Control of Level Process using an Industrial Type PLC
9. (i) Study of DCS Field Device Interface Modules (AI, AO, DI, DO, H1 Modules)  
(ii) Interfacing Analog/Digital Input/output Devices with an Industrial Type DCS
10. (i) Interfacing HART and FF enabled Field Devices with Industrial Type DCS.  
(ii) Demonstration of PID Control in Field Devices.
11. Interfacing Wireless HART enabled Field Devices with DCS

**Contact Periods:**

Lecture : Nil

Tutorial :Nil Practical : 45 Periods

Total : 45 Periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Get hands on experience in working with Industrial Automation Systems
- CO2:** Configure PLC and DCS
- CO3:** Monitor and control a plant using PLC/DCS
- CO4:** Work efficiently as a member of different teams related to multidisciplinary projects.
- CO5:** Acquire skills to communicate efficiently and gain skills related to industry / research organizations.

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	H	H	H	L	M	H	L	M	H	L	H	L	L
CO2	H	H	H	H	H	L	M	H	L	M	H	L	H	L	L
CO3	H	H	H	H	H	L	M	H	L	M	H	L	H	L	L
CO4	L	L	L	L	L	L	L	H	L	H	H	L	H	L	L
CO5	L	L	L	L	L	L	L	H	L	H	H	L	H	L	L
16NEE708	M	M	M	M	M	L	M	H	L	M	H	L	H	L	L

**L- Low, M-Moderate (Medium), H-High**

**16NEE801****PROJECT WORK****CATEGORY : EEC**

L	T	P	C
0	0	16	8

**Pre- Requisite: Nil****COURSE OBJECTIVES:**

- \* To use the knowledge acquired in various subjects of Electronics and Instrumentation Engineering.
- \* To motivate students to come up with new designs, Fabrication, Developing algorithms and software programs expressing their ideas in a novel way.
- \* To learn methodology to select a good project and able to work in a team leading to development of hardware/software product.

**PROJECT**

A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design, fabrication of Sensor/Actuator/Controller, a research investigation, or a design problem. The progress of the project is evaluated based on a minimum of two reviews. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners based on oral presentation and the project report.

**Contact Periods:**

Lecture : Nil                      Tutorial :Nil    Practical : 240 Periods                      Total : 240 Periods

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

- CO1:** Select a good project and able to work in a team leading to development of hardware/software product.
- CO2:** Prepare a good technical report and able to present the ideas with clarity.
- CO3:** Gain Knowledge on various terminologies related to industrial environment.
- CO4:** Able to work efficiently as a member of different teams related to multidisciplinary projects.
- CO5:** Acquire skills to communicate efficiently and gain management skills related to industry / research organizations.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	H	H	M	H	H	H	M	H	H	M	M	M	H
CO2	H	M	H	H	M	M	M	L	M	M	H	M	H	M	M
CO3	H	M	L	M	L	M	M	M	M	M	H	H	H	L	M
CO4	H	H	H	H	M	M	M	L	M	M	H	H	H	M	M
CO5	M	H	H	M	M	M	L	M	M	H	H	H	M	M	H
16NEE801	M	M	H	M	M	M	M	M	M	M	H	H	H	M	M

**L- Low, M-Moderate (Medium), H-High**

**16NPEX01 MODERN CONTROL THEORY****CATEGORY :PE**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

**Pre- Requisite:**

1. 16NSS1Z2 Engineering Mathematics- I
2. 16NPC501 Control systems

**COURSE OBJECTIVES**

- \* To provide knowledge on design in state space approach and analysis.
- \* To provide knowledge in phase plane analysis.
- \* To provide adequate knowledge in the time response of systems and steady state error analysis.
- \* To introduce stability analysis for non linear systems.

**UNIT - I : STATE SPACE APPROACH****9**

Review of matrices-co-ordinate transformation - Eigen values and Eigen vectors - Diagonalization - Cayley - Hamilton theorem. Solution to state-space equations, State transition matrix, Properties of state transition matrix, Computation of state transition matrix.

**UNIT - II : STATE SPACE ANALYSIS.****9**

State space analysis - State space formulation- State space representation of control systems described by scalar differential equation - State variable- Transformation of state space equation, physical, phase and canonical variable, state space models.

**UNIT - III : CONTROLLABILITY AND OBSERVABILITY.****9**

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 - IV : PHASE VARIABLE MATRIX AND REDUCIBILITY****9**

Controllable phase variable form, observable phase variable form, reduced order observer - full order observer-reducibility, irreducibility, transfer function matrix, impulse response functions.

**UNIT - V : NON LINEAR SYSTEM AND STABILITY****9**

Non-linear systems - Properties of non linear system - describing function for simple non linearity's like ON-OFF, dead zone and saturation- Phase plane method - basic concept, singular points - constructing phase plane trajectory for linear and nonlinear second order systems. Stability: BIBO, Asymptotic stability, introduction to Lyapunov stability criteria.

**Contact Periods:**

Lecture : 45 Periods      Tutorial : Nil      Practical : Nil      Total : 45 Periods

**Text Books :**

1. Benjamin C. Kuo “*Digital control systems*” Oxford University Press, 2004
2. Ogata K.H “*State Space Analysis Of Control Systems* ” Prentice Hall Publications, 1967

**Reference Books:**

1. Gopal M, Second Edition “*Modern Control Theory*” Wiley Eastern Publishers, 1993.
2. Tou T.J. “*Modern control theory*” McGraw-Hill publications, 1964
3. Nagarath I.J. & Gopal.M “*Control Systems Engineering*” Second Edition, Wiley & Sons, 1985.
4. Torkel Glad & Lennart Ljung “*Control Theory - Multi Variable and Non-linear Methods*” Taylor’s & Francis Group, 2002.
5. Hasan Saeed.S, “*Automatic Control Systems*” S.K. Kataria & Sons, 2002.
6. George J. Thaler, “*Automatic Control Systems*” Jaico Publishing house, 1993

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.
- CO2:** Interpret characteristics of the system to develop mathematical model.
- CO3:** Identify and analyze non-linear systems using describing function analysis and Phase plane method
- CO4:** Apply the reducibility and irreducibility techniques in Industrial process.
- CO5:** Analyze linear and non-linear systems using Lyapunov function for stable systems

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	M	M	M	L	L	L	L	M	M	L	H	H	H
CO2	H	H	H	H	M	L	L	L	L	M	L	M	H	H	H
CO3	M	H	M	M	M	L	L	L	L	L	L	M	H	H	H
CO4	H	H	M	M	M	L	L	L	L	L	L	M	H	H	H
CO5	H	H	H	H	H	M	M	L	L	L	L	L	H	H	H
16NPEX01	H	H	M	M	M	M	L	L	L	L	L	M	H	H	H

**L- Low, M-Moderate (Medium), H-High**

**16NPEX02**

**DIGITAL CONTROL SYSTEM**

**CATEGORY: PE**

**Pre- Requisite**

1 16NPC501 Control Systems

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

- \* To disclose the essentials and component structure related to Z-transform and its usage in digital control.
- \* To teach the distinct stability tests for digital control.
- \* To demonstrate various types of controller for desired specifications in digital control.
- \* To build and analyze state space models of discrete control systems.

**UNIT - I : COMPUTER CONTROL SYSTEM 9**

Introduction to Computer Control System-Need for computer in a control system-Functional block diagram of Data Acquisition system-Sequence Control- Direct Digital Control- Supervisory Control- Hierarchy concept-Distributed system –Introduction to MIMO process.

**UNIT - II : SAMPLED DATA CONTROL SYSTEM 9**

Review of Z-transform, Building blocks of a computer control system, Representation and analysis of sampled data control systems-Pulse Transfer function-Zero Order Hold and First Order Hold-Sampling Theorem- Sampling frequency Consideration-Modified Z transform of systems with dead time.

**UNIT - III : STABILITY AND DESIGN 9**

Introduction-Jury Stability Test- Schur-Cohn stability Test- Bilinear transformation- Stability by Pole Location – Root locus method- Bode Plot- Nyquist Plot.

**UNIT - IV : DIGITAL CONTROLLER DESIGN 9**

Digital PID controller – Dead-beat control and Dahlin’s control- ringing – Smith predictor – Digital Feed-forward controller – IMC- State Feedback Controller - LQG Control- Kalman's approach - discrete equivalent to an analog Controller - design for Set point and load changes. Selection of sampling time. Dead-time Compensation - Smith Predictor Algorithm.

**UNIT - V : DISCRETE STATE SPACE 9**

State equation – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete data transfer functions – State diagrams of discrete data systems – System with zero-order hold – Controllability and observability of linear time invariant discrete data system – Stability tests of discrete-data system – State Observer.

**CONTACT PERIODS**

Lecture : 45 Periods      Tutorial : Nil      Practical : Nil      Total : 45 Periods

**Text books :**

1. Gopal, M. “*Digital Control and State Variable Methods*” Tata McGrawHill, 2003.
2. Deshpande. Pm, and Ash “*Elements of Computer Control System*” ISA Press, USA, 1998.

**Reference books:**

1. C.L. Smith “*Digital Computer Process Control*” Intext Educational Publishers, 1972.
2. Coughanowr, D.R. “*Process Systems Analysis and Control*” McGraw - Hill International Edition, 2004.
3. Richard. H, Middleton and Graham. C, Goodwin “*Digital Control and Estimation A Unified Approach*” Prentice Hall NJ, 1990.
4. Dale Seborg. E, Thomas. F, Edgar, Duncan. A, Mellichamp “*Process Dynamics and Control*”, Willey India, 2006.

**COURSE OUTCOME:**

On completion of this course, the students will be able to

- CO1:** Explain the components of sampling and Digital control system.
- CO2:** Analyse Pulse transfer functions and data hold devices.
- CO3:** Test the stability in discrete domain.
- CO4:** Tune digital PID and to formulate steps of IMC, smith predictor algorithm.
- CO5:** Perform state variable model analysis for discrete systems.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	H	H	H	L	M	H	H	H	H	M	H	H	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	L	H	H	H	M	H	H	M	H	H	L	H	M	H
CO4	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
CO5	L	L	H	H	M	L	L	H	L	M	H	L	H	M	H
16NPEX02	L	L	H	H	H	M	L	H	M	M	M	L	H	M	H

**L- Low, M-Moderate (Medium), H-High**



**16NPEX03 FOUNDATION OF MACHINE LEARNING SYSTEMS CATEGORY: PE**

<b>Pre- Requisite : NIL</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
	3	0	0	3

**COURSE OBJECTIVES**

- \* To describe the properties and operations of Crisp and Fuzzy set.
- \* To familiarize the fuzzification, memberships, lambda cuts, extension principle, DSW algorithm and defuzzification.
- \* To define terminologies of Hybrid control schemes and GA.

**UNIT - I : INTRODUCTION TO NEURAL NETWORKS 9**

Motivation for the development of neural networks - artificial neural networks - biological neural networks - application areas. Typical architectures - setting weights - common activation functions. McCulloch-pitts neuron: architecture, algorithm, applications. Simple neural networks for pattern classification: Architecture, biases and thresholds, linear separability, data representation - Hebb Net: algorithm and application - Architecture, algorithm and application of perceptron - perceptron learning rule convergence theorem - delta rule.

**UNIT - II : NEURAL NETWORK ALGORITHMS 9**

Back propagation algorithm (BPA) –Recurrent neural network (RNN) – Adaptive resonance theory (ART) based network – Radial basis function network – online learning algorithms, BP through time – RTRL algorithms –Reinforcement learning. Kohonen’s Self Organizing map- 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**

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-Fuzzy logic Controller : Functional diagram. Membership functions: Triangular, Trapezoidal - scale factors.

**UNIT - IV : FUZZY CONTROLLER STRUCTURE 9**

Fuzzy Logic controller – Fuzzification –Knowledge base – Decision making logic – Defuzzification Fuzzification : Membership value assignments using intuition - knowledge base. Defuzzification :Max-Membership principle - centroid method - weighted average method - rule base. Choice of variable - derivation of rules, data base. Modelling of nonlinear systems using fuzzy models(Mamdani and Sugeno) –Takagi-Sugeno-Kang (TSK) model– Case study : Fuzzy logic Controller design for a temperature process.

**UNIT - V : HYBRID CONTROL SCHEMES 9**

Neuro fuzzy systems –Adaptive neuro fuzzy inference system(ANFIS) – Introduction to GA – Optimization of membership function and rule base using Genetic Algorithm- Basic concept of Genetic algorithm – flow chart of GA – Genetic representations –encoding – Initialization and selection, Genetic operators – Mutation, Generational Cycle.

**CONTACT PERIODS**

Lecture : 45 Periods      Tutorial : Nil      Practical : Nil      Total : 45 Periods

**Text books :**

1. Laurene. V, Fausett “*Fundamentals of Neural Networks, Architecture, Algorithms, and Applications*”, Pearson Education, 2008
2. Timothy. J, Ross “*Fuzzy Logic with Engineering Applications*”, Wiley, Third Edition, 2010.
3. Goldberg “*Genetic Algorithm in Search, Optimization and Machine learning*”, Addison Wesley Publishing Company Inc. 1989.

**Reference books:**

1. Jacek. M. Zurada “*Introduction to Artificial Neural Systems*” Jaico Publishing House, 1999
2. Miller W.T, Sutton R.S and Webrose “*Neural Networks for Control*” MIT Press, 1996
3. Driankov D, Hellendoorn H. and Reinfrank M “*An Introduction to Fuzzy Control*” Narosa Publishing House, New Delhi, 1996
4. Zimmermann. H.J "Fuzzy set theory-and its Applications" Springer International edition, 2011
5. EthemAlpaydin “*Introduction to Machine learning (Adaptive Computation and Machine Learning series)*” MIT Press, 2004.

**COURSE OUTCOME:**

On completion of this course, the students will be able to

- CO1:** Construct appropriate Neural Network Models for basic digital circuit applications.
- CO2:** Describe the architecture of training networks viz Organizing Maps & Propagation networks.
- CO3:** list and differentiate the properties and operations of Crisp and Fuzzy sets and define Membership functions and to find relation and composition of two fuzzy sets.
- CO4:** perform fuzzification and defuzzification using different methods.
- CO5:** define the terminologies of Genetic algorithm and to formulate the design of ANFIS controller.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	H	H	H	L	M	H	H	H	H	M	H	H	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	L	H	H	H	M	H	H	M	H	H	L	H	M	H
CO4	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
CO5	L	L	H	H	M	L	L	H	L	M	H	L	H	M	H
16NPEX03	M	M	H	H	H	M	L	H	M	M	M	M	H	M	H

**L-Low, M-Moderate, (Medium), H-High**

16NPEX04

ADVANCED PROCESS CONTROL

CATEGORY: PE

**Pre- Requisite**

- 1 16NPC501 Control systems
- 2 16NPC602 Process control

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

- To impart knowledge about multi-loop, multivariable, batch control schemes and their control strategies.
- To get adequate knowledge about stability of digital system.

**UNIT - I : ADVANCED CONTROL TECHNIQUES**

9

Brief review of dynamic behaviour of processes, single-loop feedback control systems, stability analysis and design of feedback control systems – Enhanced single loop control strategies – selective control/override systems, nonlinear control systems, adaptive control systems – PID enhancements: anti-reset windup, auto-tuning, gain scheduling and self tuning Time delay compensation.

**UNIT - II : MODEL BASED CONTROL SYSTEMS**

9

Parameter estimation using linear regression and least squares – state space and transfer function representations and their inter relationships – Internal model control preliminaries and model predictive control – model predictive control elements and algorithms – commercial model predictive control schemes – case study: distillation column control. Prediction for SISO models.

**UNIT - III : MULTI-LOOP AND MULTIVARIABLE CONTROL SYSTEMS**

9

Process interaction and control loop interaction, pairing of controlled and manipulated variables – selection of manipulated variables and controlled variables – tuning of multi-loop PID control systems – decoupling and multivariable control strategies – strategy for reducing control loop interaction – centralized MVC systems. Case study: control of mixing tank using multivariable control concept. Singular value analysis.

**UNIT - IV : BATCH CONTROL AND PLANT WIDE CONTROL**

9

Batch control systems: control during the batch – run-to-run control – batch scheduling and hierarchy. Plant wide control issues – steady state and dynamic effects of recycle – control and optimization hierarchy – plant wide control examples: MPN and HDA process – interaction of plant design and control system design. Case study: HDA process (Toluene hydro-dealkylation process) Sequential and logic control.

**UNIT - V : DIGITAL CONTROLLERS**

9

State space representation of discrete data systems – modified Z-transform - stability of discrete data system – Jury's stability test – digital PID – position and velocity form – Deadbeat algorithm – Dahlin's algorithm – Kalman's algorithm – pole placement controller – dead time compensation – Smith predictor algorithm. Canonical form for discrete time system.

## CONTACT PERIODS

Lecture : 45 Periods    Tutorial : Nil    Practical : Nil    Total : 45 Periods

## Text books :

1. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp “ *Process Dynamics and Control*” John Wiley & sons, 2010
2. B. Wayne Bequette “*Process Control: modelling, Design, and simulation*” PHI learning Pvt. Ltd., New Delhi, 2008
3. E. F. Camacho, C. Bordons, Eduardo F. Camacho “*Model Predictive Control in the Process Industry*” Springer, 2007

## Reference books:

1. M. Chidambaram “*Computer Control of Processes*” Narosa publishing house, 2010
2. Thomas E. Marlin, Marlin Thomas “*Process Control: Designing Processes And Control Systems for Dynamic Performance*” McGraw Hill Publication, 2000
3. Lennart Ljung, Ellen J. Ljung “*System Identification: Theory for the user*” Prentice Hall, 1999
4. Pradeep B. Deshpande, Raymond H. Ash “*Computer Process Control With Advanced Control Applications*” Instrument Society of America, 1988
5. Ray Ogunnaike, Babatunde A. , et.al “*Process Dynamics, Modeling, And Control*” Oxford University Press, 1994.

## COURSE OUTCOME:

On completion of this course, the students will be able to

- CO1: Understand the concept of computing the future output of a plant based on available data and proposed control action
- CO2: Model a physical process and understand the controller characteristics, selection of controller mode and control schemes.
- CO3: Obtain optimum controller settings using various tuning methods.
- CO4: Analyze/select final control elements for real-time systems
- CO5: Apply complex control schemes for various, application

## COURSE ARTICULATION MATRIX:

CO	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	H	M	M	M	L	M	L	M	M	H	M	M	H	M	M
CO2	H	H	H	M	M	L	M	M	H	M	M	L	H	H	M
CO3	H	H	H	H	M	M	L	M	L	M	M	M	H	H	M
CO4	H	H	H	H	M	L	M	L	M	M	M	L	H	H	L
CO5	M	M	H	H	M	M	L	M	M	M	M	L	M	H	M
16NPEX04	H	M	H	M	M	L	L	M	M	M	M	L	H	H	M

L-Low, M-Moderate, (Medium), H-High

16NPEX05

BIOMEDICAL INSTRUMENTATION

CATEGORY: PE

Pre- Requisite : NIL

L	T	P	C
3	0	0	3

### COURSE OBJECTIVES

- To explore the physical foundations of biological systems and electrodes used.
- To give a knowledge about the various electro physiological measurements in human body.
- To present terminologies of the measurement of non-electrical parameter in the human body.
- To explain the basic concepts of various medical imaging techniques and their applications.

### UNIT - I : PHYSIOLOGY

9

Man instrument system – Problems encountered in measuring a living system – Transducers for biomedical applications – Cell and its structure – Resting and action potential – Propagation of action potentials – The heart and cardiovascular system - Electrophysiology of cardiovascular system – Physiology of the respiratory system – Nervous system - Central nervous system and Peripheral nervous system – Electrode theory – Bio-potential electrodes.

### UNIT - II : ELECTRO PHYSIOLOGICAL MEASUREMENT

9

ECG – Vector cardiographs – EEG – EMG – ERG – EOG – Lead system and recording methods – Typical waveforms.

### UNIT - III : NON- ELECTRICAL PARAMETER MEASUREMENTS

9

Measurement of blood pressure, blood flow and cardiac output – Plethysmography – Measurement of heart sounds – Gas analysers – Blood gas analysers – Oximeters.

### UNIT - IV : MEDICAL IMAGING AND TELEMETRY

9

X-ray machine – Echocardiography – Computer tomography – MRI – Diagnostic ultrasound – PET – SPECT – Electrical impedance tomography – Thermograph – Biotelemetry.

### UNIT - V : ASSISTING AND THERAPEUTIC DEVICE

9

Pacemakers – Defibrillators – Ventilator – Anaesthesia machine – Nerve and muscle stimulator – Heart lung machine – Kidney machine – Audiometers – Diathermy – Endoscopes – Lasers in biomedicine.

### CONTACT PERIODS

Lecture : 45 Periods

Tutorial : Nil

Practical : Nil

Total : 45 Periods

### Text Books :

- 1 Leslie Cromwell “*Biomedical Instrumentation and Measurement*” PHI, New Delhi, 2007.
2. Khandpur. R.S “*Handbook of Biomedical Instrumentation*” 2nd edition, Tata McGraw Hill, 2011.

## Reference books:

1. Geddes L. A. and Baker L. E. “*Principles of Applied Biomedical Instrumentation*” 3rd Edition, John Wiley, New York, 1989
2. Richard Aston “*Principles of Bio-medical Instrumentation and Measurement*” Merrill Publishing Company, New York, 1990
1. Ed. Joseph D. Bronzino “*The Biomedical Engineering Handbook*” Second Edition, BocaRaton, CRC Press LLC, 2000

## COURSE OUTCOME:

- CO1:** To understand the physical foundations of biological systems and the various electrodes used in medical field.
- CO2:** To have a detailed understanding about the various electro physiological measurements in the human body.
- CO3:** To gain knowledge on the measurement of non-electrical parameter in the human body.
- CO4:** To describe the basic concepts of various medical imaging techniques and their applications.
- CO5:** To explain the working of medical assisting and therapy equipments.

## COURSE ARTICULATION MATRIX

CO	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	M	M	L	L	L	L	M	H	L	L	L	M	H	M	L
CO2	M	M	L	M	L	M	M	H	L	M	M	L	H	L	L
CO3	L	L	L	M	L	M	M	H	M	L	H	M	H	L	M
CO4	L	M	L	M	L	M	M	H	M	M	M	H	H	M	M
CO5	L	L	L	M	L	L	M	H	L	M	H	L	H	M	H
16NPEX05	L	M	L	M	L	M	M	H	L	M	M	M	H	M	L

**L- Low, M-Moderate (Medium), H-High**

**16NPEX06 INSTRUMENTATION STANDARDS CATEGORY: PE**

<b>Pre- Requisite: NIL</b>	L	T	P	C
	3	0	0	3

**COURSE OBJECTIVES**

\* To impart basic knowledge on Instrumentation standards.

**UNIT - I STANDARDS ORGANIZATION 9**

Standards: Introduction to International and National Standards organization: IEC, ISO, NIST, IEEE, ISA, API, BIS, DIN, JISC and ANSI. API: Process Measurement and Instrumentation (API RP551): recommended practice for installation of the instruments – flow, level, temperature, pressure - Process Instrument and Control (API RP554): performance requirements and considerations for the selection, specification, installation and testing of process instrumentation and control systems.

**UNIT - II ISA STANDARDS 9**

Documentation of Measurement and Control, Instruments and System (ISA 5): 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 - General Requirements for Electrical Equipment in Hazardous Location (ISA 12): 12.2, 12.4, 12.24, 12.29 – Instrument Specification Forms (ISA20): – Measurement Transducers (ISA37).

**UNIT - III ISA STANDARDS - CONTROL VALVE AND ACTUATOR 9**

Control Valve Standards (ISA75): 75.01, 75.04, 75.05, 75.7, 75.11, 75.13, 75.14, 75.23, 75.24, 75.26. Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04.

**UNIT - IV ISA STANDARDS - FOSSIL AND NUCLEAR POWER PLANTS 9**

Fossil Power Plant Standards (ISA 77): 77.14, 77.22, 77.30, 77.41, 77.42, 77.44, 77.60, 77.70. Nuclear Power Plant Standards (ISA67): 67.01, 67.02, 67.03, 67.04, 67.06.

**UNIT - V BS, ISO, IEC, & ANSI 9**

Measurement of Fluid Flow by means of Orifice Plates (ISO 5167/ BSI042) IEC 61131-3 – Programmable Controller – Programming Languages – Specification for Industrial Platinum Resistance Thermometer Sensors (BSI904) – International Thermocouple Reference Tables (BS4937) – Temperature Measurement Thermocouple (ANSIC96.1)

**CONTACT PERIODS**

Lecture : 45Periods Tutorial : Nil Practical : Nil Total : 45 Periods

**Text Books :**

1. API Recommended Practice 554 “*Process Instrumentation and Control – 3 parts*”, American Petroleum Institute, Washington, D.C., 1<sup>st</sup> Edition, 2008.
2. ISA standard 5 “*Documentation of Measurement and Control Instruments and Systems*”, ISA, North Carolina, USA.

**Reference Books:**

1. ISA standard 20 “*Instrument Specification Forms*” ISA, North Carolina, USA
2. ISA standard 75 “*Control Valve Standards*” ISA, North Carolina, USA.
3. ISA standard 96 “*Valve Actuator*” ISA, North Carolina, USA.
4. ISA standard 77 “*Fossil Power Plant Standards*” ISA, North Carolina, USA.
5. BS EN 60584-1 “*Thermocouples - EMF specifications and tolerances*” British Standard, 2013.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Understand the role of standards organization.
- CO2:** Interpret and follow different standards while carrying out installation of sensors, transmitters, Industrial automation systems, PLC programming, documentation, equipment selection in hazardous area and instrument specification forms.
- CO3:** Understand and follow different standards while performing control valve sizing, actuator sizing and orifice sizing etc.
- CO4:** Get acquainted with different standards for monitoring and control of fossil fuel power plants and nuclear power plants.
- CO5:** Select Specify, Install and Test Process instrumentation and control systems.

**COURSE ARTICULATION MATRIX:**

CO	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	L	L	L	L	M	L	L	L	L	L	L	L	H	H	H
CO2	H	H	H	H	M	L	L	M	M	M	M	H	H	H	H
CO3	M	L	L	H	H	L	L	L	M	L	L	L	H	H	H
CO4	M	L	L	H	H	L	L	L	M	L	L	L	H	H	H
CO5	M	H	M	H	H	L	L	L	H	M	H	M	H	H	H
16NPEX06	M	M	M	H	H	L	L	L	M	M	M	M	H	H	H

**L- Low, M-Moderate (Medium), H-High**



16NPEX07

**FIBRE OPTICS AND LASER  
INSTRUMENTATION**

**CATEGORY: PE**

**Pre- Requisite : NIL**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

- To elaborate the fundamentals of optic fibre and laser, types, properties and the losses.
- To detail the measurement of various quantities like pressure, temperature, level, distance, acceleration etc and holography and medicinal applications of laser.
- To describe the holographic techniques.

**UNIT - I FUNDAMENTALS OF OPTICAL FIBRE 9**

Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicer – Fibre termination – Optical sources – Optical detectors.

**UNIT - II MEASUREMENT USING OPTICAL FIBRES 9**

Fibre optic sensors – Fibre optic instrumentation system - Measurement of pressure, temperature, current, voltage, liquid level and strain.

**UNIT - III FUNDAMENTALS OF LASER 9**

Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

**UNIT - IV MEASUREMENT USING LASERS 9**

Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

**UNIT - V HOLOGRAPHY AND MEDICAL APPLICATIONS 9**

Holography – Basic principle - Methods – Holographic interferometry and application, Holography for non-destructive testing. Medical applications of lasers - Laser instruments for surgery and removal of tumors.

**CONTACT PERIODS**

Lecture : 45 Periods      Tutorial : Nil      Practical : Nil      Total : 45 Periods

**Text books :**

1. John M. Senior “*Optical Fiber Communications: Principles And Practice*” Pearson Education, 3<sup>rd</sup> Edition, 2009.
2. Wilson and Hawkes “*Opto Electronics - An Introduction*” Prentice Hall, 3rd Edition, 1998.

**Reference books:**

- 1 R.P.Khare “*Fibre Optics and Optoelectronics*” Oxford Press, 2004.
2. John F. Read “*Industrial Applications of Lasers*” Academic Press, 2<sup>nd</sup> Edition, 1997
3. M. Arumugam “*Optical Fibre Communication and Sensors*” Anuradha Agencies, 2002
4. P Bhattacharya “*Semiconductor optoelectronics*” Prentice Hall, 2<sup>nd</sup> Edition, 2003.

**COURSE OUTCOME:**

On completion of this course, the students will be able to

- CO1:** Define the basic concepts, different types of fibre and also the losses involved in the fibres.
- CO2:** Elaborate the fibre optic sensors used in the measurement of pressure, temperature. level etc
- CO3:** Define the fundamental characteristics and properties of laser and its configuration
- CO4:** Apply laser in instrumentation for the measurement of pressure, temperature, distance and current
- CO5:** Elaborate the holographic techniques and applications of laser in medical field

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO2	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO3	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO4	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO5	H	H	M	M	M	M	L	H	L	M	L	L	H	L	L
16NPEX07	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L

**L- Low, M-Moderate (Medium), H-High**

**16NPEX08****MEMS AND NANO TECHNOLOGY****CATEGORY: PE****Pre- Requisite**

		L	T	P	C
1	16NBS1Z3 Material science	3	0	0	3
2	16NBS2Z3 Engineering physics				

**COURSE OBJECTIVES**

- Illustrate the fundamentals and working principle of MEMs and nano technology
- Describe methods by which micro and nano-scale manufacturing and characterization
- Bring awareness about the nano-scale products and their importance in multidisciplinary fields.

**UNIT - I MEMS****9**

Introduction, emergence, devices and application, scaling issues, materials for MEMS, Thin film deposition, lithography and etching.

**UNIT - II MICROSYSTEM FABRICATION PROCESSES****9**

Introduction to Microsystems Fabrication Process, Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition (CVD), 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**

History of Nanotechnology, Introduction & overview of Quantum concepts. Overview of 1st, 2nd and 3rd generation biomaterials, structures and properties of 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 & NANO-ELECTROMECHANICAL SYSTEMS AND MICRO-FLUIDICS****9**

**MEMS/NEMS:** Magnetic, Chemical and Mechanical Transducers –Sensing and Actuators.  
**Microfluidics:** Laminar flow, Hagen-Peouisse equation, basic fluid ideas, Special considerations of flow in small channels, mixing. Micro valves and micro pumps.

**UNIT - V INDUSTRIAL APPLICATIONS****9**

Molecular electronics, molecular switches, mechanical cutting tools, machine components, magnets, DLC coated grinding wheels. Electrical, electronic, solar cells, Batteries, fuel cells, Nanofilters. Medical nanotechnology: in Diagnostics, Therapeutics, Drug delivery and Nanosurgery.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial : Nil

Practical : Nil

Total : 45 Periods

**Text Books :**

1. Tai Ran Hsu “*MEMS & Microsystem Design and Manufacture*” Tata McGraw Hill, New Delhi 2002
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.

**Reference Books:**

1. Krzysztof Iniewski., Vikas Choudhary. “*MEMS: Fundamental Technology and Applications (Devices, Circuits, and Systems)*” CRC press,2013
2. Marc Madou “*Fundamentals of Micro fabrication*” 2/e ,CRC Press, 2002
3. Julian W. Gardner and Vijay K. Varadan “*Micro sensors, MEMS, and Smart devices*” John Wiley & Sons Ltd, 2001
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, New Delhi, 2007.

**COURSE OUTCOMES:**

On completion of this course, the students will be able

- CO1:** To understand the impact of various steps needed to be followed in micro and nano scale material preparation.
- CO2:** To analyze methods involving preparation of micro and nano scale devices
- CO3:** To provide wide information dealing with micro and nano material and its necessity.
- CO4:** Critically analyze micro systems technology for technical feasibility as well as practicality.
- CO5:** To draw well-founded conclusions applying the knowledge acquired from research and research methods of nano science and MEMS.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	L	L	M	M	L	M	M	M	M	H	M	M	H
CO2	M	M	L	L	M	M	L	M	M	M	M	H	M	M	H
CO3	M	M	L	L	M	M	L	M	M	M	M	H	M	M	H
CO4	M	M	L	L	M	M	L	M	M	M	M	H	M	M	H
CO5	M	M	L	L	M	M	L	M	M	M	M	H	M	M	H
16NPEX08	M	M	L	L	M	M	L	M	M	M	M	H	M	M	H

**L-Low, M-Moderate(medium), H-High**

**16NPEX09**

**AIRCRAFT INSTRUMENTATION**

**CATEGORY: PE**

**Pre-Requisite**

1 16NPC501 Control Systems

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

- \* To develop into the basic concepts of air instruments and mechanisms.
- \* To extract Euler's angles and kinematic equations for flight paths.
- \* To individuate the aircraft propulsion systems.
- \* To patternize aircraft related to stability using stability analysis.
- \* To construct state space model of an aircraft using dynamics.

**UNIT - I : AIR CRAFT AND AEROSPACE INSTRUMENTATION 9**

Air craft and aerospace vehicle instrumentation: Air data instruments: altimeter, air speed rate of climb –gyroscopic instruments – turn and back indicator – artificial horizon – directional Gyro Schuler Tuning, Stable Platform – Automatic pilots – integrated flight instruments – Capacitance type fuel level indicating system – altitude compensation – magnetic compass. Aircraft Instrument Elements and mechanisms- Pitot- static instruments –Primary Flight Instruments- Heading Indicating Instruments-Remote Indicating compasses.

**UNIT - II : AIRCRAFT EQUATIONS OF MOTION 9**

Conservation of Linear ,Angular Momentum Equations with rotor effects-Euler angles-Flight path Equations-Kinematic equations-Gravity equations-Equations at Steady-state and Perturbed Conditions.

**UNIT - III : AIRCRAFT PERFORMANCE AND MODELING 9**

Different Aircraft Propulsion systems-Propeller-Turboprop Aircraft Engine-Turbojet – Turbofan- Modelling of Thrust forces and moments during steady state and perturbation.

**UNIT - IV : AIRCRAFT STABILITY AND DESIGN 9**

Aircraft Static Stability-Longitudinal analysis-Lateral Directional analysis-Lift chart – Trim diagram- Application of Laplace Transforms to Longitudinal Perturbation Equations and Lateral Directional analysis - Routh-Hurwitz analysis of Longitudinal Stability-Dynamic modes-Solution of Longitudinal Equations-Rolling,Spiral and Dutch roll.

**UNIT - V : STATE VARIABLE MODELLING OF AIRCRAFT DYNAMICS 9**

State variable modeling of Longitudinal Dynamics-Lateral Directional Dynamics-Modelling of Altitude, Flight path angle, Engine Dynamics, Actuator Dynamics, Atmospheric Turbulence.

**CONTACT PERIODS**

Lecture: 45Periods

Tutorial: Nil

Practical: Nil

Total: 45 Periods

**Text Books:**

1. Pallett E.G.H. “*Aircraft Instrumentation and Integrated Systems*” Longman Scientific and Technical,1992.
2. Nagaraja N.S. “*Elements of Electronic Navigation*” Tata McGraw Hill Publishing Ltd., New Delhi, 1975.

**Reference Books:**

1. Mekinley, J.L. and Bent, R.D. “*Aircraft Power Plants*” McGraw-Hill, 1993.
2. Pallet, E.H.J “*Aircraft Instruments & Principles*” Pitman & Co., 1993.
3. McKinley, J.L., and Bent, R.D. “*Aircraft Maintenance & Repair*” McGraw-Hill, 1993.
4. Marcello R. Napolitano “*Aircraft Dynamics -From Modeling to Simulation*” John Wiley & Sons, Inc., 2012.
5. Jan R. Wright, Jonathan E. Cooper “*Introduction to Aircraft Aero elasticity and Loads*” John Wiley & Sons, Inc., 2007.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Know about aircraft terminologies and gyro operation.
- CO2:** Write the equations of motion considering both steady state and perturbations.
- CO3:** Know about different types of Aircraft Systems.
- CO4:** Analyse the stability of aircraft Systems.
- CO5:** Derive the state variable model for aircraft dynamics.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	L	H	H	H	M	L	H	M	H	H	M	H	H	M
CO4	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
CO5	L	L	H	H	M	L	L	H	L	M	H	L	H	M	H
16NPEX09	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

**L- Low, M-Moderate (Medium), H-High**

**16NPEX10**

**ROBOTICS AND ITS APPLICATIONS**

**CATEGORY: PE**

**Pre-Requsite:**

			L	T	P	C
1	16NBS1Z2	Engineering Mathematics -I	3	0	0	3
2	16NBS2Z2	Engineering Mathematics –II				

**COURSE OBJECTIVES**

- \* To introduce basic concepts of various dynamics processes
- \* To educate on the effect of various power sources and sensors.
- \* To impart knowledge on the manipulators, grippers and robot dynamics
- \* To introduce the evaluation criteria and tuning techniques of controllers
- \* To introduce the concept of multi loop control techniques

**UNIT - I : BASIC CONCEPTS.**

**9**

Origin and various generation of Robots - Robot definition - Robotics system components - Robot classification Coordinate frames - Asimov's laws of robotics - degree of freedom - dynamic stabilization of robots - work volume. Need for Automation - types of automation - fixed, programmable and flexible automation.

**UNIT - II : POWER SOURCES AND SENSORS.**

**9**

Hydraulic, pneumatic and electric drives - determination of HP of motor and gearing ratio - variable speed arrangements - path determination - micro machines in robotics - machine vision - ranging - laser - acoustic - magnetic, fibre optic and tactile sensors.

**UNIT - III : MANIPULATORS, ACTUATORS, GRIPPERS AND ROBOT DYNAMICS.**

**9**

Construction of manipulators - manipulator dynamics and force control - electronic and pneumatic manipulator control circuits - end effectors - various types of grippers - design considerations. Introduction to Robot Dynamics - Lagrange formulation - Newton Euler formulation - Properties of robot dynamic equations.

**UNIT - IV : KINEMATICS AND PATH PLANNING.**

**9**

Forward Kinematics - Denavit Hartenberg Representation - Multiple solution - Jacobian work envelope, Inverse Kinematics - Geometric approach. Hill climbing techniques.

**UNIT - V : PROGRAMMING LANGUAGES AND APPLICATIONS.**

**9**

Robot programming - Fixed instruction, sequence control, General programming language, Specific programming languages. Robots for welding, painting and assembly - Remote Controlled robots - robots in manufacturing and non- manufacturing applications - Robots for nuclear and chemical plants.

**CONTACT PERIODS**

Lecture : 45 Periods      Tutorial :Nil      Practical :Nil      Total : 45 Periods

**Text Books:**

1. Deb.S.R., “*Robotics technology and flexible Automation*” John Wiley, USA 1992.
2. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G. “*Industrial Robotics*” McGraw-Hill Singapore, 1996.

**Reference Books:**

1. Ghosh “*Control in Robotics and Automation: Sensor Based Integration*” Allied Publishers, Chennai, 1998.
2. Asfahl C.R. “*Robots and Manufacturing Automation*” John Wiley, USA 1992.
3. Klafter R.D., Chimielewski T.A., Negin M. “*Robotic Engineering - An integrated approach*” Prentice Hall of India, New Delhi, 1994.
4. Mc Kerrow P.J . “*Introduction to Robotics*” Addison Wesley, USA, 1991.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Understand the automation and brief history of robot and applications.
- CO2:** Analyze the principles of various Sensors and their applications in robots.
- CO3:** Build mechanical structures for robots.
- CO4:** Familiarize with the kinematic motions of robot in Path planning
- CO5:** Apply the Programming methods & various Languages of robots.

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	M	M	H	M	M	L	H	M	M	H	H	H	H
CO2	H	H	H	H	H	M	M	M	M	M	H	H	H	H	H
CO3	H	H	H	H	H	M	M	M	M	M	H	H	H	H	H
CO4	H	H	H	H	M	M	M	L	L	L	H	H	H	H	H
CO5	H	H	H	M	M	M	L	M	H	L	M	L	H	H	H
16NPEX10	H	H	H	M	M	M	M	M	M	M	M	H	H	H	H

**L- Low, M-Moderate (Medium), H-High**



**16NPEX11**

**REAL TIME EMBEDDED SYSTEMS**

**CATEGORY: PE**

**Pre- Requisite**

1 16NPC504 Microprocessors and Microcontroller

L T P C

3 0 0 3

**COURSE OBJECTIVES**

- \* To elaborate the basic concepts of embedded systems and the details about the design of processor hardware.
- \* To provide knowledge on basics of embedded C language.
- \* To describe the advanced processor technology and real time operating systems.

**UNIT - I : INTRODUCTION TO EMBEDDED SYSTEMS**

**9**

Embedded system model – embedded standards – block diagrams – 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 - II : PROCESSOR HARDWARE**

**9**

Internal processor design: ALU – registers – control UNIT - clock – on chip memory – processor i/o – interrupts – processor buses – processor performance.

**UNIT - III : EMBEDDED PROGRAMMING**

**9**

C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization – In-line Assembly.

**UNIT - IV : ARM ARCHITECTURE**

**9**

Architecture – memory organization – addressing modes – I/O Memory – EEPROM – I/O Ports – SRAM –Timer –UART – Interrupt Structure- Serial Communication with PC – ADC/DAC Interfacing.

**UNIT - V : REAL TIME OPERATING SYSTEMS**

**9**

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – issues in distributed system: states, events, clocks-Distributed scheduling-Fault & recovery. RTOS Task and Task state –Multithreaded Preemptive scheduler- Process Synchronization- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronization problem – Deadlocks.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial: Nil

Practical : Nil

Total : 45 Periods

**Text Books :**

1. Rajkamal “*Embedded Systems Architecture, Programming and Design*” Tata McGraw Hill, 2<sup>nd</sup> Edition, 2008.
2. Steve Furber “*ARM system on chip architecture*” Pearson Education, 2<sup>nd</sup> Edition, 2015.

**Reference Books:**

1. Silberschatz, Galvin, Gagne “*Operating System Concepts*” John Wiley, 6<sup>th</sup> Edition, 2003.
2. David E Simon “*An Embedded Software Primer*” Addison Wesley, 2003.
3. Tammy Noergaard “*Embedded system architecture*” Elsevier, 2006
4. Jean J. Labrosse “*Embedded Systems Building Blocks: Complete and Ready-To-Use Modules in C*” The publisher, Paul Temme, 2011.
5. Jonathan W. Valvano “*Embedded Microcomputer Systems, Real Time Interfacing*” Brooks cole, 2004.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Define the various architectures and the basic concepts of embedded processors
- CO2:** Illustrate the hardware involved with the internal processor design
- CO3:** Program the basic problems using embedded C programming
- CO4:** Explain the Arm architecture, its memory organization and the addressing modes.
- CO5:** Elaborate the basic concepts of real time operating systems

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	M	M	L	L	L	L	L	M	L	L	H	L	L
CO2	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO3	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
CO4	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
CO5	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
16NPEX11	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L

**L- Low, M-Moderate (Medium), H-High**

16NPEX12

**AUTOMOTIVE ELECTRONICS FOR  
ELECTRICAL ENGINEERING**

**CATEGORY: PE**

(Common To EEE)

**Pre- Requisite : NIL**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

- \* To familiarize the fundamentals of automotive electronics.
- \* To explain the fuel injection and ignition systems.
- \* To illustrate sensors used in automobiles.
- \* To facilitate the analysis and design of control systems in automobiles.
- \* To teach the different safety systems used in automobiles.

**UNIT - I : FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS 9**

Evolution of electronics in automobiles, emission laws, introduction to Euro standards, equivalent Bharat standards, Charging systems: Working and design of charging circuit, alternators, requirements of starting system, starter motors and starter circuits.

**UNIT - II : IGNITION AND INJECTION SYSTEMS 9**

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**

Working principle and characteristics of airflow rate, engine crank shaft 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 9**

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.

**UNIT - V : CHASSIS AND SAFETY SYSTEMS 9**

Traction control system, cruise control system, electronic control of automatic transmission, antilock braking system, electronic suspension system, working of airbag, centralised door locking system, climate control of cars.

**CONTACT PERIODS**

Lecture: 45Periods

Tutorial :Nil

Practical: Nil

Total : 45 Periods

**Text Books :**

1. Tom Denton “*Automobile Electrical and Electronic Systems*” Arnold Publishers, Fourth Edition 2012.
2. William B Ribbens “*Understanding Automotive Electronics*” Sixth Edition, Newnes Publishers, sixth edition, 2003.

**Reference Books:**

1. V A W Hillier “*Fundamentals of Automotive Electronics*” OUP Oxford, Second Edition 2001.
2. Ronald K Jurgen “*Automotive Electronic Handbook*” McGraw Hill, Second Edition, 1999.
3. Robert Bosch “*Automotive Electrics and Automotive Electronics*” Springer, Fifth Edition, 2014.
4. Bogdan M. Wilamowski, J. David Irwin “*The Industrial Electronics Handbook*” CRC Press, Second Edition, 2011.
5. NPTEL Lecture

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Perceive the electronics involved in automotive systems
- CO2:** Understand the fundamentals involved in ignition systems
- CO3:** Choose appropriate sensors for automobiles based on applications
- CO4:** Work as a team and implement simple and safe control systems in automobiles
- CO5:** Analyse the safety issues that occur in automotive systems

**COURSE ARTICULATION MATRIX:**

CO	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	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO2	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO3	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO4	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L
CO5	M	M	L	L	L	L	L	L	L	L	L	L	L	L	L
16NPEX12	M	L	L	L	L	L	L	L	L	L	L	L	L	L	L

**L- Low, M-Moderate (Medium), H-High**

16NPEX13

**FUNDAMENTALS OF DIGITAL IMAGE  
PROCESSING**

**CATEGORY: PE**

**Pre- Requisite**

		L	T	P	C
1	16NPC603 Fundamentals of Digital signal Processing	3	0	0	3

**COURSE OBJECTIVES**

- \* To understand the fundamental DIP algorithms and implementation;
- \* To gain experience in applying image processing algorithms to real problems.

**UNIT - I : DIGITAL IMAGE PROCESSING 9**

Introduction to digital image processing-Elements of Digital Image Processing system-Visual perception and properties of human eye-Image representation-Some basic relationship between pixels-Image geometry.

**UNIT - II : IMAGE ENHANCEMENT 9**

Image enhancement- Histogram modelling, equalization and modification. Image smoothing , Image crispening. Spatial filtering, Replication and zooming, Generalized cepstrum and homomorphism filtering.

**UNIT - III : IMAGE RESTORATION 9**

Image restoration- image observation models. Inverse and Wiener filtering. Filtering using image transforms. Constrained least-squares restoration. Generalized inverse, SVD and interactive methods. Recursive filtering. Maximum entropy restoration. Bayesian methods.

**UNIT - IV : IMAGE DATA COMPRESSION 9**

Image data compression- sub sampling, Coarse quantization and frame repetition. Pixel coding - PCM, entropy coding, run length coding Bit-plane coding. Predictive coding. Transform coding of images. Hybrid coding and vector DPCM. Inter-frame hybrid coding.

**UNIT - V : IMAGE ANALYSIS 9**

Image analysis- applications, Spatial and transform features. Edge detection, boundary extraction, AR models and region representation. Moments as features. Image structure. Morphological operations and transforms. Texture Scene matching and detection. Segmentation and classification.

**CONTACT PERIODS**

Lecture : 45 Periods      Tutorial : Nil      Practical : Nil      Total : 45 Periods

**Text Books :**

1. Russ J.C. "*The Image Processing Handbook*" 5th Edition, CRC, 2006
2. Gobi E.S. "*Digital Image processing using MatLAB*" Scitech publications, 2006
3. [http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/Digi\\_Img\\_Pro](http://www.nptel.iitm.ac.in/courses/Webcourse-contents/IIT-KANPUR/Digi_Img_Pro)

**Reference Books:**

1. Jain A.K. “*Fundamentals of Digital Image Processing*” PHI, 1995
2. Gonzalez R.C. & Woods R.E. “*Digital Image Processing*” 2nd Edition, Pearson, 2002.
3. William K Pratt “*Digital Image Processing*” John Willey 2001
4. Millman Sonka, Vaclav Hlavac, Roger Boyle “*Image Processing Analysis and Machine Vision*” Thompson Learning, 1999.
5. Chanda S., Dutta Majumdar “*Digital Image Processing and Applications*” Prentice Hall of India, 2000.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Gain knowledge of feature extraction techniques for image analysis and recognition.
- CO2:** Become skilled at different techniques employed for the enhancement of images both in spatial and frequency domain.
- CO3:** Explore causes for image degradation and to teach various restoration techniques.
- CO4:** Evaluate the image compression techniques in spatial and frequency domain.
- CO5:** Analyze the need for image transforms, types and their properties.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	M	H	L	M	M	M	M	H	M	H	M	L	H
CO2	M	M	M	H	L	M	M	M	M	H	M	H	M	L	H
CO3	M	M	M	H	L	M	M	M	M	H	M	H	M	L	H
CO4	M	M	M	H	L	M	M	M	M	H	M	H	M	L	H
CO5	M	M	M	H	L	M	M	M	M	H	M	H	M	L	H
16NPEX13	M	M	M	H	L	M	M	M	M	H	M	H	M	L	H

**L- Low, M-Moderate (Medium), H-High**

**16NPEX14 SMART AND WIRELESS INSTRUMENTATION CATEGORY: PE**

<b>Pre- Requisite</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1 16NPC306 Sensors and Transducers	3	0	0	3

**COURSE OBJECTIVES**

\* To provide the adequate knowledge on smart instrumentation and wireless networks.

**UNIT - I SENSORS 9**

Sensor Classification-Thermal sensors-Humidity sensors-Capacitive Sensors-Planar Inter digital Sensors-Planar Electromagnetic Sensors-Light Sensing Technology-Moisture Sensing Technology- Carbon Dioxide (CO<sub>2</sub>) sensing technology-Sensors Parameters.

**UNIT - II WIRELESS SENSOR NETWORK 9**

Frequency of Wireless communication-Development of Wireless Sensor Network based Project-Wireless sensor based on Microcontroller and communication device-Zigbee Communication device.

**UNIT - III ENERGY HARVESTING 9**

Power sources- Energy Harvesting –Solar and Lead acid batteries-RF Energy /Harvesting-Energy Harvesting from vibration-Thermal Energy Harvesting-Energy Management Techniques-Calculation for Battery Selection.

**UNIT - IV DATA TRANSMISSION 9**

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. A brief review of signal processing techniques for structural health monitoring.

**UNIT - V APPLICATIONS 9**

WSN based physiological parameters monitoring system- Intelligent sensing system for emotion recognition-WSN based smart power monitoring system.

**CONTACT PERIODS**

Lecture : 45 Periods      Tutorial : Nil      Practical :Nil      Total: 45 Periods

**Text Books:**

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

**Reference Books:**

1. Uvais Qidwai “*Smart Instrumentation: A data flow approach to Interfacing*” Chapman & Hall; 1st Edn, December 2013.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Understand the operation for the different types of smart sensors.
- CO2:** Gain knowledge on the important terms related to development of Wireless Sensor Network.
- CO3:** Analyze and select the Solar and Lead acid batteries for energy Management Techniques
- CO4:** Gain knowledge on the important terms related to signal processing techniques for structural health monitoring.
- CO5:** Understand the operation for the WSN based physiological parameters monitoring system

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO2	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO3	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO4	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO5	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
16NPEX14	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M

**L- Low, M-Moderate (Medium), H-High**





**16NPEX15**

**POWER PLANT INSTRUMENTATION**

**CATEGORY: PE**

**Pre-requisite**

			L	T	P	C
1	16NPC503	Industrial Instrumentation I	3	0	0	3
2	16NPC601	Industrial Instrumentation II				
3	16NPC602	Process Control				

**COURSE OBJECTIVES**

- \* To familiarize about different power generation process.
- \* To lecture about the important process variables and their measurements.
- \* To learn about the important control loops involved in thermal power plants.
- \* To familiarize the student with the knowledge of turbines and their control.

**UNIT - I : METHODS OF POWER GENERATION**

**9**

Methods of power generation – hydro, thermal, nuclear, solar and wind power –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**

Measurement of feed water flow, air flow, steam flow and coal flow – Drum level measurement– Steam pressure and temperature measurement – Turbine speed and vibration measurement – Flue gas analyzer – Fuel composition analyzer.

**UNIT - III : ANALYZERS IN POWER PLANTS**

**9**

Flue gas oxygen analyzer - analysis of impurities in feed water and steam - dissolved oxygen analyzer - chromatography - pH Meter - Fuel analyzer -pollution monitoring instruments.

**UNIT - IV : CONTROL LOOPS IN BOILER**

**9**

Combustion Control-air/fuel ratio control - furnace draft control - drum level control - main steam and reheat steam temp control - super heater control - attemperator – de-aerator control -distributed control system in power plants - interlocks in boiler operation.

**UNIT - V ; TURBINE AND CONTROL**

**9**

Types of steam turbines – impulse and reaction turbines – compounding – Turbine governing system– Speed and Load control – Transient speed rise – Free governor mode operation – Automatic Load Frequency Control – Turbine oil system – Oil pressure drop relay – Oil cooling system– Turbine run up system.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial : Nil

Practical :Nil

Total: 45 Periods

**Text Books:**

1. Sam Dukelow “*Control of Boilers*” Instrument Society of America, 1991
2. Gill.A.B “*Power Plant performance*” Butterworth and Co (Publishers) Ltd, 2003

**Reference Books:**

1. Liptak B.G “*Instrumentation in Process Industries*” Chilton Book Company, 2005.
2. Jain R.K “*Mechanical and Industrial Measurements*” Khanna Publishers, New Delhi, 1999.
3. Krishnaswamy, K. and Ponnibala.M “*Power Plant Instrumentation*” PHI Learning Pvt. Ltd., New Delhi, 2011.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Understand the operation of hydro, thermal, nuclear, wind and solar power plants.
- CO2:** Select instruments for monitoring various parameters related to thermal power plant.
- CO3:** Analyze and select appropriate control strategy for Boiler.
- CO4:** Gain knowledge on the important terms related to turbine monitoring system and able to analyze the problems related to turbine governing.
- CO5:** Design instrumentation systems for electricity generating plants.

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO2	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO3	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO4	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
CO5	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M
16NPEX15	H	M	M	M	L	M	M	H	H	H	M	M	H	L	M

**L- Low, M-Moderate (Medium), H-High**

16NPEX16

**INSTRUMENTATION AND CONTROL  
IN PETRO CHEMICAL INDUSTRIES**

**CATEGORY: PE**

**Pre- Requisite:**

			L	T	P	C
1	16NPC503	Industrial Instrumentation-I	3	0	0	3
2	16NPC601	Industrial Instrumentation-II				
3	16NPC602	Process Control				

**COURSE OBJECTIVES**

- \* To familiarize the methods of crude oil extraction, processing and refining
- \* To familiarize on UNIT - operations in petroleum refinery and petrochemical industry
- \* To introduce Production routes of important petrochemicals
- \* To provide knowledge on control of selected Petrochemicals production processes
- \* To familiarize on the safety in instrumentation systems

**UNIT - I : DISTILLATION COLUMNS & REACTORS. 9**

Introduction to petroleum exploring, processing and refining constituents of crude oil - Piping and Instrument diagram of petroleum refinery. Instrumentation and control in distillation columns: distillation equipment- variable and degrees of freedom - measurement and control of column pressure - liquid distillate - Vapour distillate and inerts - control of feed, re-boiler and reflux - use of gas chromatograph-cascade and feed forward controls. Temperature control and pressure control in batch reactors.

**UNIT - II : DRYERS AND HEAT EXCHANGERS 9**

Control of batch dryers and continuous dryers.- Instrumentation and control in heat exchangers: variables and degree of freedom - liquid to liquid heat exchangers - steam heaters - condensers – re-boilers and vaporizers -use of cascade and feed forward control.

**UNIT - III : CONTROL OF PUMPS 9**

Centrifugal pumps- ON-OFF control-pressure control-flow control- throttling control Rotary pump - Reciprocating pumps- throttling.

**UNIT - IV : EFFLUENT AND WATER/ WASTE WATER TREATMENT 9**

Chemical oxidation - chemical reduction - neutralization - precipitation - biological control - waste water management process.

**UNIT - V : EVAPORATORS AND INTRINSIC SAFETY 9**

Types Of Evaporators - Measurement and Control of Absolute Pressure, Density, Conductivity, Differential Pressure And Flow In Evaporators- Intrinsic Safety Of Instruments.

**CONTACT PERIODS**

Lecture : 45 Periods      Tutorial : Nil      Practical :Nil      Total: 45 Periods

**Text Books :**

1. Bela. G. LIPTAK “*Instrumentation in the Processing Industries*” Chilton Book Company, 1994.
2. Considine D.M “*Handbook Of Applied Instrumentation*” Mcgraw Hill, 1964.

**Reference Books:**

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

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Develop the control algorithms for various distillation column to meet petroleum industry requirements.
- CO2:** Have an in-depth understanding of the various control circuits for chemical reactors and various dryers.
- CO3:** Control heat exchangers, and evaporators and to meet petroleum industry requirements.
- CO4:** Evolve the appropriate control strategy for selective UNIT - operations in a refinery.
- CO5:** Understand safety instrumentation followed in process industries.

**COURSE ARTICULATION MATRIX:**

CO	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	H	H	H	H	H	M	M	L	L	M	M	M	H	H	H
CO2	H	M	M	M	M	M	L	L	L	L	M	M	H	H	H
CO3	H	H	H	H	H	M	M	L	L	M	M	M	H	H	M
CO4	H	H	H	H	H	M	M	L	L	M	M	M	H	H	M
CO5	H	M	M	M	M	M	L	L	L	L	M	M	H	H	M
16NPEX16	H	M	M	M	M	M	M	L	L	M	M	M	H	H	M

**L- Low, M-Moderate (Medium), H-High**

**16NPEX17**                      **INDUSTRIAL INTERNET OF THINGS (IIoT)**                      **CATEGORY: PE**

**Pre- Requisite : NIL**

L	T	P	C
3	0	0	3

### **COURSE OBJECTIVES**

\* To explain in a concise manner how the Internet of Things work in industry.

#### **UNIT - I : INTERNET OF THINGS** **9**

Internet in general and Internet of Things: layers, protocols, packets, services, performance parameters of a packet network as well as applications such as web, Peer-to-peer, sensor networks, and multimedia.

#### **UNIT - II : LAYERS IN IoT** **9**

Transport services: TCP, UDP, socket programming. Network layer: forwarding and routing algorithms (Link, DV), IP-addresses, DNS, NAT and routers.

#### **UNIT - III : LOCAL AREA NETWORKS** **9**

Local Area Networks, MAC level, link protocols such as: point-to-point protocols, Ethernet, WiFi 802.11, cellular Internet access, and Machine-to-machine and IoT Analytics.

#### **UNIT - IV : INDUSTRIAL AUTOMATION** **9**

Service-oriented architecture-based device integration, SOCRADES: realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things.

#### **UNIT - V : IoT APPLICATIONS FOR INDUSTRY** **9**

Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, 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**

Lecture : 45 Periods	Tutorial : Nil	Practical :Nil	Total: 45 Periods
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### **Text Books:**

1. Dr. Ovidiu Vermesan, Dr. Peter Friess “*Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems*” River Publishers, 2013
2. Vijay Madiseti and Arshdeep Bahga, “*Internet of Things (A Hands-on-Approach)*” 1<sup>st</sup>Edition, VPT, 2015
3. Adrian McEwen “*Designing the Internet of Things*” Wiley Publishers, 2013

### **Reference Books:**

1. Manoel Carlos Ramon “*Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers*” Apress, 2014.
2. Mark Harrison, Florian Michahelles “*Architecting the Internet of Things*” Springer – 2011
3. Olivier Hersent, David Boswarthick, Omar Elloumi “*The Internet of Things – Key applications and Protocols*” Wiley, 2012

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Understand the vision of IoT from a global context.
- CO2:** Understand constraints and oppUNIT -ies of wireless and mobile networks for Internet of Things.
- CO3:** Use of Devices, Gateways and Data Management in IoT.
- CO4:** Apply the IoT in Industrial Automation and Real World Design Constraints.
- CO5:** Analyse trade-offs in interconnected wireless embedded sensor networks

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	L	L	M	H	M	M	M	M	M	M	H	M	M
CO2	H	M	L	L	M	H	M	M	M	M	M	M	H	M	M
CO3	H	M	L	L	M	H	M	M	M	M	M	M	H	M	M
CO4	M	M	M	H	H	M	L	M	M	L	M	M	M	M	M
CO5	M	M	M	H	H	M	L	M	M	L	M	M	M	M	M
16NPEX17	H	M	M	M	M	M	M	M	M	M	M	M	M	M	M

**L- Low, M-Moderate (Medium), H-High**



**16NPEX18**

**SAFETY INSTRUMENTED SYSTEMS**

**CATEGORY: PE**

**Pre- Requisite:**

L T P C

1 16NPC602 Process Control

3 0 0 3

**COURSE OBJECTIVES**

- \* To make aware of basic concepts of safety instrumented system, standards and risk analysis techniques.
- \* To make the students understand different layers of protection.
- \* To make students conscious about safety instrumentation applications.

**UNIT - I : INTRODUCTION**

**9**

Safety Instrumented System (SIS): need, features, components, difference between basic process control system and SIS - Risk: how to measure risk, 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 - Process Control vs Safety Control.

**UNIT - II : PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS**

**9**

Prevention Layers: Process Plant Design, Process Control System, Alarm Systems, 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**

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**

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**

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, Lifecycle 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**

Lecture : 45 Periods

Tutorial :Nil

Practical :Nil

Total: 45 Periods

**Text Books :**

1. Paul Gruhn and Harry L. Cheddie ” *Safety Instrumented systems: Design, Analysis and Justification*” ISA, 2<sup>nd</sup> 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.

**Reference Books:**

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.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Understand the role of safety instrumented system in the industry.  
**CO2:** Identify and analyze the hazards.  
**CO3:** Select the safety integrity level for an application.  
**CO4:** Understand the importance of safety environment in industry and demonstrate the knowledge of safety and need for sustainable development  
**CO5:** Interpret the results and draw meaningful conclusions through proper documentation

**COURSE ARTICULATION MATRIX:**

CO	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	H	L	H	M	H	H	M	M	L	M	L	L	H	H	H
CO2	H	H	H	L	H	H	H	M	L	L	L	L	H	H	M
CO3	L	H	H	M	H	H	M	L	L	L	L	L	H	H	M
CO4	L	L	M	L	M	H	H	M	L	L	L	H	M	H	M
CO5	H	H	H	H	M	M	M	L	L	L	L	M	L	M	H
16NPEX18	M	M	M	M	M	H	M	M	L	L	L	M	L	H	M

**L- Low, M-Moderate (Medium), H-High**



<b>16NPEX19</b>	<b>UNIT OPERATIONS OF PROCESS</b>	<b>CATEGORY: PE</b>			
<b>Pre- Requisite:</b>		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
1	16NES302 Thermal Engineering and Fluid Mechanics	3	0	0	3

**COURSE OBJECTIVES**

- \* To study the UNIT - operations involved for transportation, mixing and separation of solids and fluids.
- \* To understand the basic operations involved with heat exchangers, Distillation and chemical reactions.
- \* To gain knowledge about the operations of evaporators and crystallizers, drying and cooling towers.

**UNIT - I : MECHANICAL OPERATIONS- I 9**

Operations on Solids: General Characteristics of solids, Storage and conveying of solids: bunkers, silos, bins and hoppers, transport of solids in bulk, conveyor selection, different types of conveyors. Estimation of particle size - Screening methods and equipment. Adjusting particle size: methods of size reduction, classification of equipment, crushers, grinders. size enlargement- Principle of granulation, briquetting, pelletisation and flocculation. Mixing: mixing of powders. Separation: Electrostatic and magnetic separators, applications.

**UNIT - II : MECHANICAL OPERATIONS-II 9**

Operations on Fluids: Transport of fluids, Mixing and agitation: Mixing of liquids, selection of suitable mixers. Separation: Gravity settling, sedimentation, thickening, double cone classifier, centrifugal separation. Cyclones - Operation, equipment, control and applications.

**UNIT - III : HEAT TRANSFER- I AND ITS APPLICATIONS 9**

Heat exchangers: Single pass and multi pass heat exchangers, condensers, re-boilers, Combustion process in thermal power plant, Distillation: Binary distillation, Batch distillation, controls and operations, Chemical reactors.

**UNIT - IV : HEAT TRANSFER- II 9**

Theory of evaporation – single effect and multiple effect evaporators – Crystallization – nucleation and growth – classification of crystallizers. Drying: classification of Dryers, batch and continuous dryers, dryers for solids and slurries and cooling Towers, Refrigeration.

**UNIT - V : CASE STUDY 9**

Unit operations and Control schemes applied to Thermal Power plant, Steel Industry, Paper and Pulp Industry, Leather Industry.

**CONTACT PERIODS**

Lecture : 45 Periods                      Tutorial :Nil                      Practical :Nil                      Total : 45 Periods

**Text Books :**

1. Balchen ,J.G., and Mumme, K.J. 1. “ *Process Control structures and applications*” Van Nostrand Reinhold Co., New York, 1988.
2. Warren L. McCabe, Julian C. Smith and Peter Harriot “*UNIT - Operations of Chemical Engineering*”, Graw-Hill International Edition, New York, Sixth Edition, 2001.
3. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas “*ChemicalProcess Equipment: Selection and Design*” Gu Professional Publishing, 2010.

**Reference Books:**

1. Waddams, A.L. “*Chemicals from petroleum*” Butler and Taner Ltd., UK, 1968.
2. Liptak, B.G. “*Process measurement and analysis*” Chilton Book Company, USA, 1995.
3. Luyben W.C., “*Process Modeling, Simulation and Control for Chemical Engineers*” Graw-Hill International edition, USA, 1989.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Apply the knowledge on solids & fluids to handle the raw materials.
- CO2:** Select and apply relevant handling techniques to convert the solids and fluids for specific applications.
- CO3:** Come out with solutions for simple/complex problems in heat transfer and design the heat exchange equipment for different applications such as distillation, boilers.
- CO4:** Carry out multidisciplinary projects using heat transfer, mass transfer concepts.
- CO5:** Design and analyze the performance of heat exchangers and evaporators
- CO6:** Gain ability for lifelong learning of new techniques and developments in various types of UNIT - operations in industries.

**COURSE ARTICULATION MATRIX:**

CO	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	H	M	M	M	L	L	L	L	M	M	M	L	H	H	H
CO2	H	H	H	M	H	M	M	L	L	L	M	M	H	H	H
CO3	H	H	H	H	H	M	M	L	H	H	H	H	H	H	H
CO4	H	H	H	H	H	M	M	L	H	H	H	H	H	H	H
CO5	H	H	H	H	H	M	M	L	L	M	M	M	H	H	H
CO6	M	M	M	H	H	H	M	M	M	M	H	H	M	H	H
16NPEX19	H	M	H	H	H	M	M	L	M	M	M	M	H	H	H

**L- Low, M-Moderate (Medium), H-High**

16NPEX20

ENERGY HARVESTING

CATEGORY: PE

Pre- Requisite: NIL

L	T	P	C
3	0	0	3

### COURSE OBJECTIVES

\* To familiarize with basic principles of different types of energy harvesting systems as well as methods of electro-mechanical conversion and principle of photovoltaic cells.

#### UNIT - I : ALTERNATE SOURCES OF ENERGY 9

Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, Hydroelectricity.

#### UNIT - II : SOLAR ENERGY 9

Solar energy, its importance, storage of solar energy, solar pond, non convective solar pond, applications of solar pond and solar energy, solar water heater, flat plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems.

#### UNIT - III : WIND ENERGY HARVESTING 9

Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

#### UNIT - IV : OCEAN AND HYDRO ENERGY OCEAN ENERGY 9

Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices. Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass. Hydro Energy: Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

#### UNIT - V : PIEZOELECTRIC AND ELECTROMAGNETIC ENERGY HARVESTING 9

**Piezoelectric Energy Harvesting:** Introduction, Physics and characteristics of piezoelectric effect, materials and mathematical description of piezoelectricity, Piezoelectric parameters and modelling piezoelectric generators, Piezoelectric energy harvesting applications, Human power.

**Electromagnetic Energy Harvesting:** Linear generators, physics mathematical models, recent applications. Environmental issues and Renewable sources of energy, sustainability.

### CONTACT PERIODS

Lecture : 45 Periods	Tutorial :Nil	Practical :Nil	Total : 45 Periods
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### Text Books :

1. Godfrey Boyle “*Renewable Energy, Power for a sustainable future*” 2004, Oxford University Press, in association with The Open University
2. G.D Rai “*Non-conventional energy sources* “ Khanna Publishers, New Delhi

## Reference Books:

1. Dr. P Jayakumar “ *Solar Energy: Resource Assessment Handbook*” Asian and Pacific Centre for Transfer of Technology, 2009
2. J.Balfour, M.Shaw and S. Jarosek “*Photovoltaics*” Lawrence J Goodrich (USA),2004.
3. [http://en.wikipedia.org/wiki/Renewable\\_energy](http://en.wikipedia.org/wiki/Renewable_energy)
4. M P Agarwal “*Solar energy*” S Chand and Co. Ltd,2009
5. Suhas P Sukhative “*Solar energy*” Tata McGraw - Hill Publishing Company Ltd, 2010.

## COURSE OUTCOMES:

On completion of this course, the students will be able to

- CO1:** Acquire a global view of societal energy needs, energy resources, and their geo-political distribution and potential, with an emphasis on wind, ocean current, and other renewable energy.
- CO2:** Quantify the renewable energy potential of a given source based upon the principles and fundamental technical solutions used to harvest it.
- CO3:** Understand the working knowledge of systems used to convert wind/wave/ocean current into electrical energy.
- CO4:** Understand the major design drivers shaping the wind/wave/ocean current energy harvesting technical solutions.
- CO5:** Create the Innovative, advanced concept solutions together with relevant socio-economic and environmental considerations.

## COURSE ARTICULATION MATRIX:

CO	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	H	M	M	M	L	L	L	L	M	M	M	L	H	H	H
CO2	H	H	H	M	H	M	M	L	L	L	M	M	H	H	H
CO3	H	H	H	H	H	M	M	L	H	H	H	H	H	H	H
CO4	H	H	H	H	H	M	M	L	H	H	H	H	H	H	H
CO5	H	H	H	H	H	M	M	L	L	M	M	M	H	H	H
16NPEX20	H	M	H	H	H	M	M	L	M	M	M	M	H	H	H

L- Low, M-Moderate (Medium), H-High

Pre- Requisite : Nil

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

- \* To Understand and analyze the concepts of Quantum confinement, Dimensional structures and Properties of nano systems
- \* To be familiar with various methods of synthesis of nano materials
- \* To analyze and understand the mechanical and electrical properties of nonmaterial and its applications
- \* To realize the importance of Nonporous materials and its applications
- \* To make the students to understand the fundamental aspects of properties leading to technology

**UNIT - I : NANO SYSTEMS****9**

Size effect and properties of nanoparticles - particle size - particle shape - particle density - melting point, surface tension, wettability - specific surface area and pore size – Properties of Individual nanoparticles. Quantum confinement in 3D, 2D, 1D and zero dimensional structures -Size effect and properties of nanostructures- Top down and Bottom up approach.

**UNIT - II : SYNTHESIS OF NANOMATERIALS****9**

Sol-Gel Process - Self assembly – Electro deposition - Spray Pyrolysis - Flame Pyrolysis – Metal Nanocrystals by Reduction - Solvothermal Synthesis - Chemical Vapor Deposition (CVD) – Metal Organic Chemical Vapor Deposition (MOCVD).Ball Milling - Inert Gas Condensation Technique (IGCT) – Thermal evaporation – Pulsed Laser Deposition (PLD) – DC/RF Magnetron Sputtering - Molecular Beam Epitaxy (MBE) – Melt Spinning process.

**UNIT - III : MECHANICAL AND ELECTRICAL PROPERTIES****9**

Nanoscale Mechanics - Introduction – Mechanical properties – Density Considered as an Example Property – The Elasticity of Nanomaterials – Elasticity of Bulk Nanomaterials –Plastic Deformation of Nanomaterials - The Physical Basis of Yield Strength – Crystals and Crystal Plasticity – From Crystal Plasticity to Polycrystal Plasticity.

Introduction - Energy Storage Basics - General Information: Electrical Energy Storage Devices and Impact of Nanomaterials – Batteries – Capacitors - Electrochemical Properties of Nanoscale Materials - Aerogels and Structure-Directed Mesoporous and Macroporous Solids - Nanoparticles - Nanotubes, Nanowires, and Nanorolls

**UNIT - IV : NANOPOROUS MATERIALS****9**

Nanoporous Materials – Silicon - Zeolites, mesoporous materials – nano membranes and carbon nanotubes - AgX photography, smart sunglasses and transparent conducting oxides- Hydrophobic & Hydrophilic materials – molecular sieves – nanosponges.

**UNIT - V : NANOTECHNOLOGY APPLICATIONS****9**

Applications of nanoparticles, quantum dots, Nanotubes and nanowires for nanodevice fabrication – Single electron transistors, coulomb blockade effects in ultra-small metallic tunnel junctions - nanoparticles based solar cells and quantum dots based white LEDs – CNT based transistors – principle of Dip Pen Lithography.

## CONTACT PERIODS

Lecture : 45 Periods

Tutorial :Nil

Practical:Nil

Total:45 Periods

### Reference books:

1. G. Timp. Editor, “**Nanotechnology**” AIP press, Springer-Verlag, New York, 1999
2. Hari Singh Nalwa, Editor, “**Nanostructured materials and Nanotechnology**”, Concise Edition, Academic Press, USA (2002).
3. Guozhong Gao, “**Nanostructures & Nanomaterials: Synthesis, Properties & Applications**”, Imperial College Press (2004).
4. K. T. Ramesh, “**Nanomaterials : Mechanics and Mechanisms**”, Springer 2009.
5. Kenneth J. Klabunde, “**Nanoscale materials in chemistry**”, John Wiley & Sons, 2001.
6. Hari Singh Nalwa, Editor, “**Hand book of Nanostructured Materials and Technology**”, Vol.1-5, Academic Press, USA (2000).
7. “**Hand book of Nanoscience, Engineering and Technology**” (The Electrical Engineering handbook series), Kluwer Publishers, 2002
8. N John Dinardo, Weinheim, “**Nanoscale characterization of surfaces & interfaces**”, Cambridge: Wiley-VCH, 2nd ed., 2000
9. G. Cao, “**Nanostructures & Nanomaterials: Synthesis, Properties & Applications**”,
10. Imperial College Press, 2004.
11. J.George, “**Preparation of Thin Films**”, Marcel Dekker, Inc., New York. 2005.

### COURSE OUTCOME:

- CO1** : Analyze the particle size, particle shape, particle density, Size effect and properties of Nanostructures [**Familiarity**]
- CO2** : Acquire knowledge in various methods of synthesis of Nano materials. [**Application**]
- CO3** : Analyze the Elasticity of Nanomaterials , Electrical Energy Storage Devices and Aerogels. [**Assessment**]
- CO4**: Acquire knowledge in Zeolites, mesoporous materials, nano membranes and carbon nanotubes. [**Familiarity**]
- CO5**: Apply various nano materials to the LED, Transistor Applications. [**Usage and Assessment**]

### COURSE ARTICULATION MATRIX:

CO/ PO	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		H		M		L									
CO2	M			L	H										
CO3		H			L		M						H		
CO4	H			M		L								H	
CO5	L		H				M					M			H
16AOEX01	M	H	H	M	M	L	M					M	H	H	H

**L- Low, M-Moderate (Medium), H-High**

**16AOEX02**

**MATERIAL CHARACTERIZATIONS**

**CATEGORY: OE**

*(Common to All Branches)*

L	T	P	C
3	0	0	3

**Pre-Requisite: Nil**

**COURSE OBJECTIVES:**

- To Understand and analyze the concepts of Thermo gravimetric analysis, Differential thermal analysis
- To be familiar with various methods of microscope
- To analyze and understand the working principle of SEM, FESEM, EDAX, and HRTEM
- To realize the importance of Electrical methods and its limitations
- To understand the fundamental aspects and properties of spectroscopy techniques

**UNIT – I : THERMAL ANALYSIS**

**9**

Introduction – thermo gravimetric analysis (TGA) – instrumentation – determination of weight loss and decomposition products – differential thermal analysis (DTA)- cooling curves - differential scanning calorimetry (DSC) – instrumentation – specific heat capacity measurements – determination of thermo mechanical parameters.

**UNIT – II : MICROSCOPIC METHOD**

**9**

Optical Microscopy: optical microscopy techniques – Bright field optical microscopy – Dark field optical microscopy - phase contrast microscopy - fluorescence microscopy - confocal microscopy - digital holographic microscopy - oil immersion objectives - quantitative metallography - image analyzer.

**UNIT – III : ELECTRON MICROSCOPY AND OPTICAL CHARACTERISATION**

**9**

SEM- FESEM- EDAX,- HRTEM: working principle and Instrumentation – sample preparation – Photoluminescence – light – matter interaction – instrumentation – electroluminescence – instrumentation – Applications.

**UNIT – IV : ELECTRICAL METHODS**

**9**

Two probe and four probe methods- van der Pauw method – Hall probe and measurement – scattering mechanism – C-V, I-V characteristics – Schottky barrier capacitance – impurity concentration – electrochemical C-V profiling – limitations.

**UNIT – V : SPECTROSCOPY**

**9**

Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy, ESR, NMR, NQR, ESCA and SIMS- proton induced X-ray Emission spectroscopy (PIXE) – application – mass spectroscopy.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical:Nil

Total:45 Periods

**Reference books:**

1. Stradling, R.A; Klipstain, P.C; “**Growth and Characterization of semiconductors**”, Adam Hilger, Bristol,1990.
2. Belk, J.A; “**Electron microscopy and microanalysis of crystalline materials**”, Applied Science Publishers, London, 1979.
3. Lawrence E.Murr, “**Electron and Ion microscopy and Microanalysis principles and Applications**”, Marcel Dekker Inc., New York, 1991
4. D.Kealey & P.J.Haines, “**Analytical Chemistry**”, Viva Books Private Limited, New Delhi, 2002.
5. G. Gao, “**Nanostructures and Nanomaterials**”, Imperial College Press, London, 2006
6. Y. Gogotsi, “**Nanomaterials Handbook**”, CRC Taylor and Francis, New York, 2006
7. Banwell, “**Fundamentals of Molecular Spectroscopy**”, Tata McGraw-Hill, 1994.

**COURSE OUTCOME:**

**CO1:** Analyze the properties of TGA,DTA and DSC. [Assessment]

**CO2:** Acquire knowledge in various types of microscopes. [Familiarity]

**CO3 :** Analyze the working principle and Instrumentation of SEM, FESEM, EDAX, and HRTEM [Familiarity]

**CO4:** Acquire knowledge in I-V and C-V characteristics. [Application]

**CO5:** Analyze the Principles and instrumentation of Spectroscopy methods. [Familiarity]

**COURSE ARTICULATION MATRIX:**

CO/ PO	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		H			M	M	L						H		
CO2	H	M	M				L					L			
CO3		H	M	M	L									H	
CO4	M	H		L	M										H
CO5		M	H		L	M						L			
16AOEX02	M	M	M	L	L	M	L					L	H	H	H

**L- Low, M-Moderate (Medium), H-High**



16AOEX03

**ELECTROCHEMICAL TECHNOLOGY**

**CATEGORY:OE**

*(Common to All Branches)*

L T P C  
3 0 0 3

**Pre-Requisite: Nil**

**COURSE OBJECTIVES:**

This course aims at making Mechanical Engineers know about Electro-chemical principles applied in manufacturing of Chemical products, fabrication of metals, metallurgy and corrosion studies.

**UNIT – I**

**9**

Fundamental concepts, electron transfer, mass transfer, adsorption, electro-catalysis, phase formation in electrode reaction, assessment of cell voltage, costing of electrolytic process, performance and figure of merit. Typical cell designs. Laboratory data and scale-up.

**UNIT – II**

**9**

Chlor-alkali industry-concept of brine electrolysis, chlorine cell technology, the production of NaOH. Water electrolysis, sodium chlorate, hydrogen peroxide, ozone, cuprous oxide, and synthesis of metal salt via anodic dissolution, Organic electro synthesis-dimerization of acrylonitrile, indirect electrosynthesis

**UNIT – III**

**9**

Extraction, refining and production of metal-electro-winning, cementation, electro-refining, Electro-deposition of metal powders. Corrosion and its control-thermodynamics and kinetics of corrosion reactions, corrosion problems in practice, corrosion prevention and control, corrosion problems in electrolytic processing, corrosion measurement and monitoring

**UNIT – IV**

**9**

Metal finishing - electroplating, electroless plating, conversion coatings, electroforming, electrochemical etching. Batteries and fuel cells-battery characteristics, battery specifications, evaluation of battery performance, battery components. Fuel cells.

**UNIT – V**

**9**

Water purification, effluent treatment and recycling of industrial process stream- metal ion removal and recovery, treatment of liquors containing dissolved chromium, electrolytic method of phase separation, flue gas desulphurization and electro-dialysis. Electro-chemical sensor and monitoring techniques, polarographic to anodic stripping voltammetry, ion selective electrode, electrochemical biosensors.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical:Nil

Total:45 Periods

**Text Books:**

1. Derek Pletcher and Frank C Walsh, “**Industrial Electrochemistry**”, 2<sup>nd</sup> edition, Chapman & Hall, UK, 1990

2.A.T.Kuhn, “**Industrial Electrochemistry**”, Elsevier Publishers, 1972

**Reference books:**

1. C.L. Mantell, “Chemical Engineering Series – Industrial Electrochemistry”, McGraw Hill Co., Inc. London, 1958
2. Ullmann’s “Encyclopedia of Industrial Chemistry”, John Wiley & Sons, Vol.6, pp: 399 - 481, 2003.
3. Krik–“Othmer Encyclopedia of Chemical Technology”, 4<sup>th</sup> edition, Vol: I, Pp938 –1025 (1991)
4. N.M. Prout and J.S. Moorhouse, “Modern Chlor-Alkali Technology”, Vol. IV, Elsevier Applied Science, London, 1990

**COURSE OUTCOMES:**

Students after the completion of this course:

**CO1:** Students will be able to understand the electrochemical processes and design cell requirements.

**CO2:** Students can apply the electrolysis principle in manufacture of materials required for regular use.

**CO3:** Students will be able to apply their technical skill in metallurgy.

**CO4:** Students will be able to acquire knowledge in all metal finishing techniques.

**CO5:** Students will gain knowledge in solving the problems of corrosion of equipment and battery systems.

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	L	H	M	M	H	L						L	L	H	L
<b>CO2</b>	L	M	H	L	H	L						L	L	H	L
<b>CO3</b>	H	L	H	M	M	H						L	H	M	L
<b>CO4</b>	M	L	L	L	M	H						L	M	M	L
<b>CO5</b>	L	M	H	L	H	M						L	L	H	L
<b>16AOEX03</b>	L	M	M	L	M	M						L	L	M	L

**L- Low, M-Moderate (Medium), H-High**

16AOEX04

**POLYMER TECHNOLOGY**  
(Common to All Branches)

**CATEGORY: OE**

**Pre-Requisite: Nil**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

This course is aimed to make Mechanical Engineers apply their skills in identifying the types of polymers and their properties applicable to plastics and rubber processing

**UNIT - I : CHEMISTRY OF HIGH POLYMERS** **9**

Monomers, functionality, degree of polymerizations, classification of polymers, glass transition, melting transition, criteria for rubberiness, polymerization methods: addition and condensation; metallocene polymers and other newer techniques of polymerization, copolymerization, block and graft copolymers, techniques for copolymerization-bulk, solution, suspension and emulsion.

**UNIT - II: SYNTHESIS AND PROPERTIES** **9**

Commodity and general purpose thermoplastics: PE, PP, PS, PVC, Polyesters, Acrylic, PU polymers. Engineering Plastics: Nylon, PC, ABS, Fluoropolymers - Thermosetting polymers: PF, MF, UF, Epoxy, Unsaturated polyester. Natural and synthetic rubbers: Recovery of NR hydrocarbon from latex, SBR, Nitrile, CR, CSM, EPDM, IIR, BR, Silicone, TPE.

**UNIT - III: POLYMER TECHNOLOGY** **9**

Polymer compounding-need and significance, different compounding ingredients for rubber and plastics, cross-linking and vulcanization,. Compression molding, transfer molding, injection molding, blow molding, reaction extrusion, pultrusion, calendaring, rotational molding, thermoforming, rubber processing in two-roll mill, internal mixer.

**UNIT - IV: POLYMER BLENDS AND COMPOSITES** **9**

Difference between blends and composites, their significance, choice of polymers for blending, blend miscibility-miscible and immiscible blends, FRP, particulate, long and short fibre reinforced composites.

**UNIT - V: POLYMER TESTING** **9**

Mechanical-static and dynamic tensile, flexural, compressive, abrasion, endurance, fatigue, hardness, tear, resilience, impact, toughness. Conductivity-thermal and electrical, dielectric constant, dissipation factor, power factor, electric resistance, surface resistivity, volume resistivity, swelling, ageing resistance, environmental stress cracking resistance.

**CONTACT PERIODS**

Lecture : 45 Periods      Tutorial :Nil      Practical: Nil      Total:45 Periods

**Reference Books:**

1. F.W. Billmeyer, Jr., "Textbook of polymer science", Wiley - Interscience, N.Y.(1971)
2. G.Odian , "Principles of polymerization" , , Wiley – Interscience (1981)
3. Gowarikar V.R. and others , "Polymer science", Wiley Eastern (1986).
4. Fenner R.T., "Principles of polymer processing", Chemical publishing N.Y. (1979)

**COURSE OUTCOMES:**

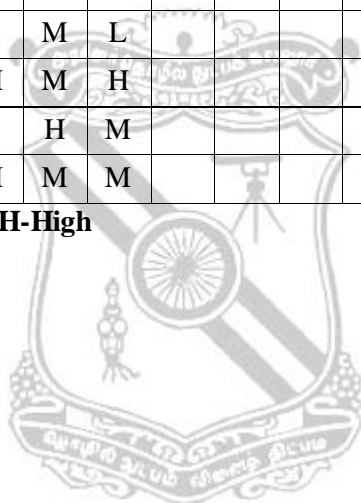
After the completion of this course, Students will be able to

- CO1:** identify different types of polymers by structure and behaviour, properties and their method of polymerisation.
- CO2:** apply various processes of fabrication of plastics and rubber.
- CO3:** distinguish polymer blends and composites and understand their specific applications.
- CO4:** test the polymer specimens for mechanical properties applicable for various end uses.
- CO5:** test the polymer specimens for electrical properties applicable for various end uses.

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	M	H	L	L	M	H						M	M	M	M
<b>CO2</b>	L	L	H	M	H	L						M	L	H	M
<b>CO3</b>	M	M	L	L	M	L						M	M	M	M
<b>CO4</b>	L	L	M	M	M	H						M	L	M	M
<b>CO5</b>	L	H	L	L	H	M						M	L	H	M
<b>16AOEX04</b>	L	M	M	M	M	M						M	L	M	M

**L- Low, M-Moderate (Medium), H-High**



**16COEX05                      DISASTER MANAGEMENT AND MITIGATION                      CATEGORY :OE**  
*(Common to All Branches)*

**Pre-Requisite:** Nil

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

- \* To give knowledge about basics of Disaster Management.
- \* To impart knowledge about Hazards and Vulnerability.
- \* To give knowledge about mitigation and preparedness.
- \* To teach about Response and Recovery.
- \* To impart knowledge about the participants involved in the disaster management activity.

**UNIT - I : INTRODUCTION 8**

Disaster throughout history, History of disaster management, Capacity by demand, UN International strategy for disaster reduction, the Hyogo framework for action, Post 2015 framework, Disaster trends.

**UNIT – II: HAZARDS AND RISK VULNERABILITY 10**

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 8**

Mitigation - types of mitigation ,Ostacles in mitigation, Assesment and selection of Mitigation options, Emergency response capacity as , 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**

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 : PARTICIPANTS 10**

Governmental Disaster management agencies-Fire, law, emergency management, Emergency medical service, Military and other resources. Structures-local, regional, national. Bilateral assistance and its types. Types of national agencies involved in international disaster management. Political implications of bilateral assistance.

Non Governmental Organisations – operations, NGO/ Military coordination, standard of conduct. The role of Private sector and academia.

Multilateral organaisations - UN agencies and progammes, Regional & International organaisations. International Financial Institutions- the world bank, IMF, ADB, IADB. Special considerations.

## CONTACT PERIODS

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

### Text Book:

1.Damon P. Coppola, **“Introduction to International Disaster management”**, Elsevier publication, 2015

### Reference Books:

1. Brassard, Caroline, Giles, David W., Howitt, Arnold M., **“Natural Disaster Management in the Asia-Pacific”**, Policy and Governance.
2. **“Disaster Management”**, Global Challenges and Local Solutions, Universities Press, 2009.
3. Jack Pinkowski, **“Disaster Management Handbook”**, CRC Press , January 22, 2008.
4. **Disaster Management Guidelines**, GOI-UNDP Disaster Risk Reduction Programme (2009-2012).

### COURSE OUTCOMES:

**CO1:** Able to get knowledge about basics of Disaster management.

**CO2:** Able to impart knowledge about Hazards and vulnerability

**CO3:** Able to know about Mitigation and preparedness.

**CO4:** Able to attain knowledge about response and recovery.

**CO5:** Able to learn about the participants involved in the disaster management activity.

### COURSE ARTICULATION MATRIX:

CO/ PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO	PSO
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
<b>CO1</b>	L	L		L	L	L	M	L				L	L	L	L	L
<b>CO2</b>	L	H		M	L	M	M	L				L	L	L	L	L
<b>CO3</b>	L	L		L	H	M	M	L				L	L	H	L	L
<b>CO4</b>	L	M		L	L	M	M	L				L	L	L	L	L
<b>CO5</b>	L	M		L	L	M	M	L				L	L	L	L	L
<b>16COEX05</b>	L	M		L	M	M	M	L				L	L	L	L	L

**L-Low, M-Moderate(medium), H-High**

16COEX06

**ENVIRONMENTAL MANAGEMENT**

**CATEGORY:OE**

*(Common to All Branches)*

L	T	P	C
3	0	0	3

**Pre-Requisites:**

1. 16NHS2Z4 Environmental Science and Engineering

**COURSE OBJECTIVES:**

\* To understand the importance of nature and study about the water, air and soil pollution control as well as solid waste management.

**UNIT - I : NATURE AND SCOPE OF ENVIRONMENTAL PROBLEMS 9**

Environment and sustainable development – Natural and human environmental disturbances – Global warming –acid rain – ozone depletion – effects and control - climate change conventions – Kyoto protocol – India’s efforts for Environmental protection – Public policy and role of NGO’s.

**UNIT - II : WATER POLLUTION AND CONTROL 9**

Fresh water and its pollution – Natural processes – sources and pollutants – pollution due to industrial, agricultural and municipal wastes – effects on streams - limitations of disposal by dilution – BOD consideration in streams – Oxygen Sag Curve – Strategies for sustainable water management – Marine environment and its management – Water acts.

**UNIT - III : AIR AND NOISE POLLUTION 9**

Pollutant emissions - sources and sink – effects of air pollution on human health, vegetation and climate– Global effects – prevention and control of air pollution – Control of particulates – Air pollution surveys and sampling – Air quality monitoring - Air Act – Management of air pollution – Sound level – Effect of noise on people – Environmental noise control- noise pollution rules, 2000.

**UNIT - IV : SOLID WASTE MANAGEMENT AND SOIL POLLUTION 9**

Sources – Characteristics – Quantities – Collection methods – Processing and disposal techniques – Onsite Handling, storage and processing – sanitary landfill – Incineration and pyrolysis – Composting – aerobic and anaerobic of composting – Recycling and reuse of solid wastes – Hazardous wastes – Definition – Sources & types only – Integrated system for waste management – The Basel convention Land use and degradation – Management problems – strategies for sustainable land management – soil pollution –wetland conservation.

**UNIT – V : ENVIRONMENTAL MANAGEMENT SYSTEM 9**

Terminology – installation and common motives of EMS – Environmental standards – ISO 14000 (Series) – basic principles – Environmental Audit – Environmental Impact assessment - Trade rules and environmental protection– Practices for Waste Minimisation and Cleaner Production.

**CONTACT PERIODS**

Lecture : 45 Periods                      Tutorial :Nil                      Practical: Nil                      Total:45 Periods

**Text Books:**

1.N.K.Uberoi, “*Environmental Management*”, Excel Books, New Delhi (2006).

2.Rao, “*Air Pollution*”, Tata McGraw-Hill Education, 01-Jun-1988

**Reference Books:**

1.S.Vigneahwaran,M.Sundaravadivel and D.S.Chaudhary , “*Environmental Management*”, SCITECH Publications(India) Pvt.Ltd, Chennai & Hyderabad (2004).

2. Technobanoglous, “*Environmental Management*”, McGraw Hill Book Company (2006).

**COURSE OUTCOME:**

**CO1:** Students exposed to know common issues related with environment.

**CO2:** Students able to know the sources, causes and effects of water pollution.

**CO3:** Able to attain knowledge related with air and noise pollution.

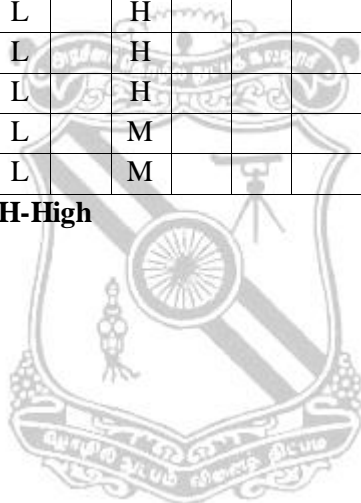
**CO4:** Able to understand the various management techniques of solid waste and soil Pollution.

**CO5:** Able to aquire knowledge on Environmental Management Systems.

**COURSE ARTICULATION MATRIX:**

CO/ PO	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	PSO 4
<b>CO1</b>	M	L			L		M					L	L	H	L	L
<b>CO2</b>	L	M			L		H					L	H	H	L	L
<b>CO3</b>	L	M			L		H					L	H	H	L	L
<b>CO4</b>	L	M			L		H					L	H	H	L	L
<b>CO5</b>	M	L			L		M					L	L	H	L	L
<b>16COEX06</b>	L	M			L		M					L	M	H	L	L

**L- Low, M-Moderate (Medium), H-High**





16COEX07

**TOWN PLANNING AND ARCHITECTURE**

**CATEGORY:OE**

*(Common to All Branches)*

L	T	P	C
3	0	0	3

**Pre-Requisite:** Nil

**COURSE OBJECTIVES:**

\* Students are introduced the basics of Town Planning and Architecture

**UNIT - I : TOWN PLANNING**

**9**

History of evolution of towns - Town and environment – Planning acts – land use classification – Transportation network - Climate, humidity, wind and radiation - Surveys and Data collection - Residential neighborhoods - Industrial areas - Public Buildings - Housing and Slum clearance.

**UNIT – II : BUILDING RULES AND GUIDELINES**

**9**

General – Zoning regulations – Regulations regarding layouts or subdivisions – Building regulations – Rules for special types of buildings – Floor space index – minimum plot size and building front age – Open spaces – Minimum standard dimensions of building elements – Provision for lighting and ventilation – Provision for means of access – Provision for urban growth.

**UNIT - III : BASIC ELEMENTS OF ARCHITECTURE**

**9**

Introduction of Architecture – Definition – Mass and space visual emotional effects of geometric forms and their derivatives– The sphere, the cube, the pyramid, the cylinder and cone – The aesthetic qualities of Architecture – Proportion, scale, balance, symmetry, rhythm and axis – contrast in form – Harmony – Consideration of comfort factors acoustics, lighting, ventilation and thermal aspects.

**UNIT – IV: PRINCIPLES OF ORIENTATION AND PLANNING OF BUILDINGS**

**9**

General – factors affecting orientation – sun – Wind – Rain – Orientation criteria for Indian conditions – Principles governing the theory of Planning – General requirements of site and building – Functional planning of buildings.

**UNIT - V : ELEMENTS OF INTERIOR DESIGN**

**9**

General – Decorative Materials – Cement Bonded Board (BISON PANEL), Water proof cement paint, Industrial glazing and Roofing, UNIT - masonry, plaster and dry wall, Wall surface materials, Effect of colour on architecture – Home furnishing– plans in rooms.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

**Text Books:**

- 1.S.C.Rangwala, “**Elements of Town Planning**”, McGraw Hill, London, 2006.
- 2.Biswas Hiranmay, “**Principles of Town Planning and Architecture**”, VAYU Education of India, 2012.

**Reference Books:**

1. V.S.Pramar, “**Design fundamentals and architecture**” Lakshmi Publishers, 2003.
2. Hiraskar, “**Fundamentals in town planning**” Khanna Publishers, 2005.

**COURSE OUTCOME :**

- CO1:** Students will be able to know about the basics of town planning and building rules.  
**CO2:** Students will be able to gain knowledge on building rules & regulations.  
**CO3:** Students able to apply the architectural principles in the area of Civil Engineering.  
**CO4:** Students will be able to do planning of various buildings.  
**CO5:** Students will be able to understand about interior design of buildings.

**COURSE ARTICULATION MATRIX:**

CO/ PO	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	PSO 4
<b>CO1</b>	M			M	L							L	M	L	L	
<b>CO2</b>	M				L		M				L	L	M	L	L	M
<b>CO3</b>	M	L		L	M					M		M	M	M	M	
<b>CO4</b>	M	L		L	M					M		L	M	M	L	
<b>CO5</b>	L	M			L			L				H	L	L	H	
<b>16COEX07</b>	M	L		L	M		M	L		M	L	L	M	M	L	M

**L- Low, M-Moderate (Medium), H-High**



16MOEX08

**TOTAL QUALITY MANAGEMENT FOR ENGINEERS**

**CATEGORY: OE**

*(Common to All Branches except Production)*

L	T	P	C
3	0	0	3

**Pre-Requisite: Nil**

**COURSE OBJECTIVES**

\* To impart knowledge to develop a product with the required quality at a reasonable price and to satisfy the requirements under various quality standards.

**UNIT - I QUALITY CONCEPTS (9)**

Definition of quality, dimensions of quality, quality planning, quality costs concepts - basic concepts of total quality management, principles of TQM, leadership concepts - quality council, quality statements, strategic planning- steps in strategic planning- Deming philosophy, barriers to TQM implementation.

**UNIT - II TQM PRINCIPLES (9)**

Contribution of TQM Gurus - customer perception of quality - retention, employee involvement - motivation, empowerment, performance appraisal, continuous process improvement – Juran trilogy, PDSA cycle, 5S concept, kaizen, supplier partnership - supplier rating – performance measures- Malcom Balridge National Quality Award.

**UNIT - III STATISTICAL PROCESS CONTROL (9)**

Seven old and new tools of quality - statistical fundamentals - population and sample – normal curve - control charts for variables ,attributes and its applications - process capability - concept of six sigma.

**UNIT - IV TOOLS AND TECHNIQUES (9)**

Benchmarking needs and benefits - benchmarking process - quality function deployment (QFD) - house of quality - Taguchi quality loss function - total productive maintenance (TPM) - pillars of TPM - Failure Mode Effective Analysis (FMEA) - Failure rate - types of FMEA - stages of FMEA - case studies.

**UNIT - V QUALITY SYSTEMS (9)**

Introduction to ISO 9000 and other quality system - ISO 9001:2015 quality system – elements - implementation of quality system - documentation - quality auditing - QS 9000, ISO 14000 - concept, requirements and benefits - integrating ISO 14000 with ISO 9000 – OSHSAS 18001, Implementation of TQM in manufacturing industry.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

**Text Books**

1. Dale H.Besterfield, et al., **“Total Quality Management”**, Pearson Education, 2008.
2. Subburaj Ramasamy, **“Total Quality Management”**, Tata McGraw Hill, 2008.
3. Vilas S.Bagad, **“Total Quality Management”**, TECHNICAL PUBLICATIONS, 2017.

## Reference Books

1. James R.Evans & William M.Lindsay, *“The Management and Control of Quality”*, Thomson Learning, 2002.
2. Feigenbaum.A.V. *“Total Quality Management”*, McGraw-Hill, 1991.
3. Zeiri, *“Total Quality Management for Engineers”* Wood Head Publishers, 1991
4. P.N.Mukherjee *“Total Quality Management”*, PHI Publishers, 2006
5. John.L Hradesky *“Total Quality Management Hand book”* McGraw-Hill, 1995.

## COURSE OUTCOMES:

On completion of this course, students will be able to

**CO1:** apply the principle of strategic planning, Deming philosophy and leadership concepts in industries.

**CO2:** apply the principle of TQM in industries.

**CO3:** apply the principle of statistical process control in industries.

**CO4:** select appropriate quality tools to meet industrial requirements.

**CO5:** implement appropriate quality standards for industries.

## COURSE ARTICULATION MATRIX:

CO/ PO	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
<b>CO1</b>	L	H			M			L	L		L	L	M	L	M
<b>CO2</b>	L	H			M			L	L		L	L	M	L	M
<b>CO3</b>	L	H			M			L	L		L	L	M	L	M
<b>CO4</b>	L	H			M			L	L		L	L	M	L	M
<b>CO5</b>	L	H			M			L	L		L	L	M	L	M
<b>16MOEX08</b>	L	H			M			L	L		L	L	M	L	M

**L-Low, M-Moderate (medium), H-High**

**16MOEX09**

**COMPOSITE MATERIALS**

*(Common to all Branches)*

**CATEGORY: OE**

L	T	P	C
3	0	0	3

**Pre-Requisites:**

1. 16NBS203 Material Science

**COURSE OBJECTIVES:**

\* To impart the fundamentals of composite materials with different reinforcement, matrix materials and comprehend the types of manufacturing methods for advance composite materials to meet various engineering requirements.

**UNIT – I INTRODUCTION TO COMPOSITE MATERIALS 9**

Types and characteristics of composite materials - Mechanical behavior - Basic terminology and Manufacture of laminated fiber - Reinforced composite materials - Current and potential advantages - Applications of composite materials.

**UNIT - II REINFORCEMENT AND MATRICES 9**

Different types of fibers - Properties and applications of fibers - Roll of matrix - Matrix materials, Selection of matrix -Thermoset matrix -Thermoplastic matrix, Fiber architecture – Natural Fibers.

**UNIT - III DESIGN OF COMPOSITE STRUCTURES 9**

Elements of Design - Steps in design process - Elements of analysis in design - Analysis iterations - Design analysis stages - Material selection - Configuration selection - Laminate joints - Design requirements and design failure criteria.

**UNIT – IV MANUFACTURING OF ADVANCED COMPOSITES 9**

Bag-Molding process-Compression molding-Pultrusion-Filament winding-Liquid composite molding processes-Resin film infusion-Elastic reservoir molding-Tube rolling-Forming methods for thermoplastic matrix composites.

**UNIT - V METAL, CERAMIC AND CARBON MATRIX COMPOSITES 9**

Metal matrix composites - Manufacturing processes - Ceramic matrix composites- Mechanical properties - Manufacturing processes - Carbon matrix composites - Fabrication methods - Applications.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

**Text Books:**

1. Krishnan K., Chawla “**Composite Materials Science and Engineering**”, Springer (India) Private Limited, 2011.
2. P.K. Mallick , “**Fiber Reinforced Composite materials, Manufacturing and Design**”, CRC Press, Taylor and Francis Group, Boca Raton, London, Newyork 2010.

**Reference Books:**

1. A.K.Bhargava, “Engineering Materials: Polymers, ceramics and composites”, Pentice Hall of India Limited, 2010.
2. Hyer M., Stress Analysis of Fiber – “Reinforced Composite Materials”, Tata McGraw Hill, 1998.
3. Madhujit Mukhopadhyay , “Mechanics of Composite Materials and Structures ”, Universities Press (India) Private Limited, 2009.
4. Robert M.Jones, “Mechanics of Composite Materials”, Taylor & Francis Group, 2010.
5. Web Portal: Composite Materials {Nptel .Mechanical Engineering }

**COURSE OUTCOMES:**

On completion of this course, students will be able to

- CO1:** understand the mechanics and behaviour of reinforced composite materials for specific applications and developing composite materials for sustainability
- CO2:** formulate different types of reinforcement and matrices to develop new composite material for the various application.
- CO3:** design and manufacture post processing methods of composite structures and capable to perform various analysis
- CO4:** execute different methods of manufacturing advanced composites to meet the innovate demand in engineering.
- CO5:** fabricate metal matrix, ceramic matrix and carbon matrix composite for various engineering application to meet the societal demand.

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	H	M	H	L	M	M	M		L		L	L	H		L
<b>CO2</b>	H	M	M	M	M	M	L		L		M	L	M	M	L
<b>CO3</b>	M	M	M	M	M	L	M		L		L	L	L	M	L
<b>CO4</b>	M	M	M	L	M	H	L		L		M	L	M	L	L
<b>CO5</b>	L	L	L	L	M	M	L		L		L	L	M	M	L
<b>16MOEX09</b>	M	M	M	L	M	M	L		L		L	L	M	M	L

**L-Low, M-Moderate(medium), H-High**

16MOEX10

**AUTOMOBILE ENGINEERING**

**CATEGORY :OE**

*(Common to all Branches)*

**Pre-Requisite:** Nil

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

The learners are able to visualize the scope of Automobile Engineering.

**UNIT - I INTRODUCTION TO AUTOMOTIVES 9**

An overview of different types of automobiles and their power sources. Specifications, Performance Parameters, Quality standards, Trends in automobile design

**UNIT - II POWER SOURCE FEATURES 9**

Reciprocating Engine systems, Rotary Engine systems, Gas Turbine systems, Hybrid systems - Pollutant emissions and their control; Catalytic converter systems, Electronic Engine management systems

**UNIT - III TRANSMISSION, SUSPENSION AND BRAKING SYSTEMS 9**

Clutch system, Gear box system, propeller shafting, differential, axles, wheels and tyres and Preliminaries of suspension systems

**UNIT - IV AUXILIARY SYSTEMS 9**

Electrical and electronic systems, safety systems, Heating, Ventilation, and Air Conditioning (HVAC) systems, Vehicle Thermal Management System and vehicle body design features.

**UNIT - V TESTS, SERVICE AND MAINTENANCE 9**

Engine Tuning, vehicle maintenance, engine and Chassis Dynamometry Pollutants and emissions Check, Wind Tunnel Tests, preliminaries of engine and vehicle testing.

**CONTACT PERIODS**

Lecture : 45 Periods                      Tutorial :Nil                      Practical: Nil                      Total:45 Periods

**Text Books:**

1. Dr. Kirpal Singh, *“Automobile Engineering Vol. I & II”*, Standard Distributors Publishers, 2012.
2. R.B.Gupta, *“Automobile Engineering”* Sathya Prakashan, New Delhi, 2006.

**Reference Books:**

1. William H.Crouse, *“Automotive Mechanics”*, McGraw Hill Book Co. 2004.
2. K.K. Ramalingam, *“Automobile Engineering – theory and Practice”* SciTech Publications, 2001.
3. Joseph Heinter *“Automobile Mechanics Principles and Practice”* Affiliated East West Press, 1997.
4. Jain K.K. and Asthana. R.B, *“Automobile Engineering”* Tata McGraw Hill Publishers, New Delhi, 2002.
5. Heinz Heisler, *“Advanced Engine Technology”* SAE International Publications USA, 1998.

**COURSE OUTCOMES:**

On completion of this course, learners will be able to:

- CO1:** Identify the different components in an automobile.
- CO2:** Clearly understand different auxiliary and transmission systems.
- CO3:** Explain the working of various parts like engine, transmission, clutch, brakes
- CO4:** Understand the environmental implications of automobile emissions
- CO5:** Develop a strong base for understanding future developments in the automobile industry

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	M	M	M	L	H	M	M	M	L	L	L	H	M	M	H
<b>CO2</b>	H	M	H	H	M	H	L	L	L	M	M	L	H	M	H
<b>CO3</b>	M	M	M	L	M	H	M	L	L	M	H	L	H	H	M
<b>CO4</b>	H	M	H	M	H	M	H	H	M	M	H	L	L	L	H
<b>CO5</b>	M	L	L	L	M	H	M	L	L	H	H	H	H	M	H
<b>16MOEX10</b>	M	M	M	M	M	M	M	L	L	M	M	L	M	M	M

**L-Low, M-Moderate(medium), H-High**





16EOEX11

**RENEWABLE ENERGY SOURCES  
AND TECHNOLOGY**

*(Common to all Branches)*

**CATEGORY: OE**

L	T	P	C
3	0	0	3

**Pre-Requisite: Nil**

**COURSE OBJECTIVE:**

- To elucidate the technologies used for generation and utilization of power from Renewable energy resources.

**UNIT - I SOLAR ENERGY**

**9**

Solar radiation, solar spectra-latitude and longitude, Declination angle, solar window, cosine law, seasonal variations, hour angle, calculation of angle of incidence, angstroms equation and constants, Photo voltaic: p-n junctions. Solar cells, PV systems, Standalone, Grid connected solar power - Types of solar thermal collectors – Flat and concentrating collectors, solar thermal applications -water heaters, dryers, stills, refrigeration, air-conditioning, solar pond, central receiver power generation.

**UNIT - II WIND ENERGY**

**9**

Wind energy - Basic principle of wind energy conversion system, wind data and energy estimation, site selection, components of wind energy conversion systems, design consideration of horizontal axis wind mill- merits and limitations- application

**UNIT - III BIOMASS ENERGY**

**9**

Biomass, sources of biomass, thermo-chemical and bio-chemical conversion of biomass - Pyrolysis, gasification, combustion and fermentation. Gasifiers – Up draft, downdraft and fluidized bed gasifier. Digesters - Fixed and floating digester biogas plants, economics of biomass power generation.

**UNIT - IV OCEAN AND GEOTHERMAL ENERGY**

**9**

Ocean energy resources - Principles of ocean thermal energy conversion systems - ocean thermal power plants - Principles of ocean wave energy conversion and tidal energy conversion - Difference between tidal and wave power generation, Economics of OTEC.

Definition and classification of Geothermal resources, Utilization for electricity generation and direct heating, Wellhead power generating UNIT -s. Overview of micro and mini hydel power generation.

**UNIT - V RENEWABLE ENERGY POLICIES**

**9**

Renewable energy policies - Feed-in tariffs, portfolio standards, policy targets, tax incentives, and biofuels mandates. International policies for climate change and energy security. Economic analysis and comparisons, Life cycle analysis, financial analysis, cost of conserved energy, and externalities. Cost assessment of supply technologies versus energy - Efficiency.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

**Text Books:**

- 1.Rao. S. and Dr. Pamlekar B.B, “**Energy Technology**”, Khanna Publishers, Second Ed. 1997
2. Pai and Ramaprasad, “**Power Generation through Renewal sources**”, Tata McGraw Hill – 1991

**Reference Books :**

- 1.Rai , G.D., "NonConventional sources of Energy", Khanna Publishers , IV Ed.,2009
- 2.Bansal NK, Kleeman and Meliss, M "Renewable Energy Sources and Conversion Techniques", Tata McGraw Hill, 1996
3. Roland Wengenmayr, Thomas Buhrke, "Renewable energy: Sustainable energy concepts for the future", Wiley-VCH, 1st edition, 2008.

**COURSE OUTCOME:**

**CO1:** Realize the need for utilizing the energy from clean and Sustainable energy resources.

**CO2:** Describe the principles of operation of the broad spectrum of renewable energy Technologies

**CO3:** Analyze energy technologies from a systems perspective.

**CO4:** Articulate the technical challenges for each of the renewable sources

**CO5:** Create solutions for alternate energy issues

**CO6:** Discuss economic, technical and sustainability issues involved in the integration of renewable energy systems

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	H	M	M	M	M	M	M	M		L	L	L	H	M	M
<b>CO2</b>	H	H	M	M	M	M	M	L		L	L	L	H	H	H
<b>CO3</b>	H	M	M	M	M	M	M	M		L	L	L	M	H	H
<b>CO4</b>	M	H	M	L	M	H	M	M		L	L	L	H	H	H
<b>CO5</b>	M	H	H	H	M	M	M	M		L	L	L	M	H	M
<b>CO6</b>	H	M	M	M	M	M	M	M		H	L	L	M	H	M
<b>16EOEX11</b>	M	M	M	M	M	M	M	M		L	L	L	M	H	M

**L- Low, M-Moderate (Medium), H-High**

16EOEX12

**SMART GRID TECHNOLOGY**

**CATEGORY:OE**

*(Common to all Branches)*

**Pre-Requisite: Nil**

L T P C

3 0 0 3

**COURSE OBJECTIVE:**

To gain knowledge on the fundamentals of smart grid technologies, its architecture and its managements. Also the students should learn many of the challenges facing the smart grid as part of its evolution.

**UNIT - I SMARTGRIDS: MOTIVATION, STAKES AND PERSPECTIVES 9**

Introduction – Information and Communication technologies serving the electrical system – Integration of advanced technologies – Definitions of SmartGrids – Objectives addressed by the SmartGrid concept – Socio-economic and environmental objectives – Stakeholders involved the implementation of the Smart Grid concept – Research and scientific aspects of the Smart Grid – SmartGrids from the customer’s point of view.

**UNIT - II INFORMATION AND COMMUNICATION TECHNOLOGY 9**

Data Communication, Dedicated and shared communication channels, Layered architecture and protocols, Communication technology for smart grids, standards for information Exchange, Information security for the smart grid - Cyber Security Standards - IEEE1686 - IEC62351.

**UNIT - III SENSING AND MEASUREMENT 9**

Synchro Phasor Technology – Phasor Measurement UNIT -, Smart metering and demand side integration - Communication infrastructure and protocol for smart metering – Data Concentrator, Meter Data Management System. Demand side Integration – Services, Implementation and Hardware Support of DSI.

**UNIT - IV CONTROL AND AUTOMATION 9**

Distribution automation equipment – Substation automation equipments: current transformer, potential transformer, Intelligent Electronic Devices, Bay controller, Remote Terminal UNIT -. Distribution management systems – SCADA: modeling and analysis tools, applications

**UNIT - V REGULATION OF SMARTGRIDS AND ENERGY STORAGE SYSTEMS 9**

Regulation and Economic models – Evolution of the value chain – The emergence of a business model for smart grids – Regulation can assist in the emergence of SmartGrids – The standardization of SmartGrids - Energy Storage Technologies-Methods - Batteries, Flow Battery, Fuel Cell and Hydrogen Electrolyser, Flywheel, Super-Conducting magnetic energy storage system, Super Capacitor.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical:Nil

Total:45 Periods

**Text Books:**

- 1.Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, “**Smart Grid Technologies and applications**”, John Wiley Publishers Ltd., 2012
- 2.Nouredine Hadjsaid, JeanClaude Sabonnadiere, “**Smart Grids**”, Wiley Publishers Ltd., 2012
- 3.Lars T. Berger, Krzysztof Iniewski, “**Smart Grid applications, Communications and Security**”, John Wiley Publishers Ltd., 2012

**Reference Books :**

1. Yang Xiao, “Communication and Networking in Smart Grids”, CRC Press Taylor and Francis Group, 2012.
2. Caitlin G. Elsworth, “The Smart Grid and Electric Power Transmission”, Nova Science Publishers Inc, 2010

**COURSE OUTCOME:**

- CO1:** Develop and demonstrate the various aspects of the smart grid, including Technologies, Components, Architectures, Applications
- CO2:** Design a smart grid and to meet the needs of a utility, including Meeting a utility’s objectives, helping to adopt new technologies into the grid
- CO3:** Creating a framework for knowledgeable power engineers to operate the grid more effectively
- CO4:** Transfer the available information from any part of the power system to centralized control centre.
- CO5:** Handle the smart meter, sensors and intelligent devices to measure the electrical quantity.
- CO6:** Control the Electrical quantity from remote place

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	L			L	L	M	H	L	M	M	M	H	M	H	M
<b>CO2</b>	L			M	M	M	M	L	M	M	M	M	M	M	H
<b>CO3</b>	L			M	M	M	M	M	M	M	M	H	M	M	M
<b>CO4</b>	L			M	M	M	H		M	M	M	H	M	H	H
<b>CO5</b>	M			M	M	M	M		M	M	M	M	M	M	M
<b>CO6</b>	L			L	M	M	L		M	M	M	M	M	M	M
<b>16EOEX12</b>	L			M	M	M	M	L	M	M	M	M	M	M	M

**L-Low, M-Moderate, (Medium), H-High**

16LOEX13

**PRINCIPLES OF COMMUNICATION**

**CATEGORY:OE**

*(Common to all Branches)*

L	T	P	C
3	0	0	3

**Pre-Requisite: Nil**

**COURSE OBJECTIVES:**

- To understand the concepts of analog communication
- To gain the fundamental knowledge of digital communication
- To be familiar with the fundamentals of satellite and optical communication

**UNIT - I AMPLITUDE MODULATION 9**

Introduction to communication systems- Electromagnetic spectrum- Principle of amplitude modulation – AM envelope – frequency spectrum and bandwidth – modulation index and percentage of modulation – AM power distribution –AM generation and detection – square law modulator- envelope detector.

**UNIT - II ANGLE MODULATION 9**

Frequency modulation and phase modulation- FM and PM waveforms – phase deviation and modulation index – frequency deviation and percentage of modulation – Frequency analysis of angle modulated waves- Bandwidth requirements for Angle modulated waves – generation and detection of FM – Armstrong modulator- Foster Seely Discriminator.

**UNIT - III PULSE MODULATION 9**

Sampling and Quantization – Pulse Amplitude modulation- Pulse width modulation –Pulse position modulation- Pulse code modulation- PCM transmitter and receiver - Signal to Quantization noise ratio – Differential Pulse Code Modulation – Delta modulation – Adaptive Delta modulation

**UNIT - IV DIGITAL COMMUNICATION 9**

Introduction – ASK, FSK, PSK- transmitter and receiver – QPSK transmitter and receiver – M ary PSK – Error probability in PSK, FSK.

**UNIT -V SATELLITE AND OPTICAL COMMUNICATION 9**

Satellite Communication Systems-Transmitter and receiver- Kepler's Law – LEO and GEO Orbits – GEO Stationary orbit–Optical Communication Systems – Transmitter and receiver- Sources and Detectors- Types of Optical Fiber – Losses.

**CONTACT PERIODS**

Lecture : 45 Periods                      Tutorial :Nil                      Practical: Nil                      Total:45 Periods

**Text Books:**

1. Wayne Tomasi, “Advanced Electronic Communication Systems”, 6/e, Pearson Education, 2007.
2. Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons., 2008.

**Reference Books:**

1. H.Taub,D L Schilling ,G Saha ,”Principles of Communication”3/e,2007.
2. B.P.Lathi,”Modern Analog And Digital Communication systems”, 3/e, Oxford University Press, 2007
3. Blake, “Electronic Communication Systems”, Thomson Delmar Publications, 2002.
4. B.Sklar,”Digital Communication Fundamentals and Applications”2/e Pearson Education 2007.

**COURSE OUTCOMES:**

Upon completion of this course, the students will have the :

- CO1. Basic knowledge of amplitude modulation systems
- CO2. Basic knowledge of angle modulation systems
- CO3. Fundamental knowledge of digital communication systems
- CO4. Understanding of digital transmission techniques
- CO5. Fundamental knowledge of satellite communication system
- CO6. Fundamental knowledge of optical communication system

**COURSE ARTICULATION MATRIX:**

CO/ PO	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	M	M	M									L	M	L	
CO2	M	M	M									L	M	L	
CO3	M	M	M									L	L	L	
CO4	M	M	M									L	M	L	
CO5	M	M	M									L	L	L	
CO6	M	M	M									L	M	M	
16LOEX13	M	M	M									L	M	M	

L-Low, M-Moderate (medium), H-High

**16LOEX14 MICROCONTROLLERS AND ITS APPLICATIONS CATEGORY: OE**  
*(Common to all Branches)*

**Pre-Requisite: Nil** L T P C  
3 0 0 3

**COURSE OBJECTIVES:**

- To gain knowledge on basics of microcontrollers
- To get exposure to programming of microcontroller 8051
- To acquire knowledge on interfacing of peripherals with 8051 and PIC microcontrollers
- To get exposure on applications of microcontrollers

**UNIT - I INTRODUCTION TO MICROCONTROLLER 9**

Microprocessors and Microcontrollers – CISC and RISC - Fundamentals of Assembly language Programming – Instruction to Assembler – C Programming for Microcontrollers – Compiler and IDE – Introduction to Embedded systems - Architecture 8051 family - PIC 18FXXX – family – Memory organization.

**UNIT - II PROGRAMMING OF 8051 MICROCONTROLLER 9**

Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication of 8051.

**UNIT - III PROGRAMMING OF PIC18FXXX MICROCONTROLLER 9**

Instruction set – Addressing modes – I/O Programming-Timer/Counter - Interrupts – Serial communication, CCP, ECCP PWM programming of PIC18FXXX.

**UNIT - IV PERIPHERAL INTERFACING 9**

Interfacing of Relays, Memory, key board, Displays – Alphanumeric and Graphic, RTC, ADC and DAC, Stepper motors and DC Motors, I<sup>2</sup>C, SPI with 8051 and PIC family.

**UNIT - V MICROCONTROLLER APPLICATIONS 9**

Pulse measurement-measuring frequency, pulse width measurement -Speed control of DC Motor-Speed control of Stepper Motor-Traffic Light Controller and Washing Machine Controller.

**CONTACT PERIODS**

Lecture : 45 Periods                      Tutorial :Nil                      Practical: Nil                      Total:45 Periods

**Text Books:**

1. Kenneth J.Ayala., “**The 8051 Microcontroller**”, 3<sup>rd</sup> Edition, Thompson Delmar Learning, 2007, New Delhi.
2. John B. Peatman, “**PIC programming**”, McGraw Hill International, USA, 2005.

**Reference Books:**

- 1.Muhammad Ali Mazidi and Janice GillispicMazdi, “**The 8051 Microcontroller and Embedded Systems**” Pearson Education, Inc 2006.
- 2.John B. Peatman, “**Design with Micro controllers**”, McGraw Hill International, USA, 2005
- 3.James W. Stewart, “**The 8051 Micro controller hardware, software and interfacing**”, regents Prentice Hall, 2003.
- 4.David Calcutt, Fred Cowan, Hassan Parchizadeh, “**8051 Microcontroller An Application Based Introduction**”, Elsevier Publication, 1<sup>st</sup> edition,2004.
- 5.Krishna Kant, “**Microprocessor and Microcontrollers**” Eastern company edition, Prentice Hall of India, New Delhi, 2007.

**COURSE OUTCOMES:**

Upon completion of this course the student will:

**CO 1:** Acquire knowledge on the basics of microcontroller

**CO 2:** Exposure to 8051 microcontroller Programming

**CO 3:** Exposure to PIC microcontroller Programming

**CO 4:** Able to interface peripherals with microcontrollers

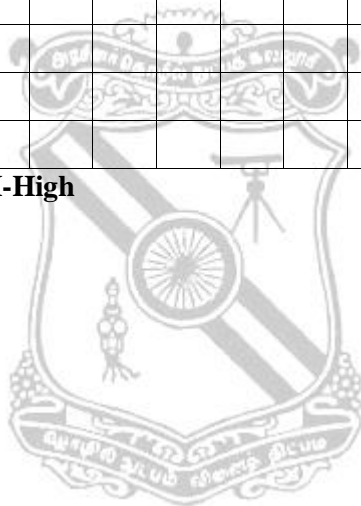
**CO 5:** Get exposure to the applications of microcontrollers

**CO 6:** Able to design microcontroller based systems

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	M	H	M									L	L	L	
<b>CO2</b>	M	H	M									M	M	M	
<b>CO3</b>	M	H	M									M	M	M	
<b>CO4</b>	M	H	M									M	M	M	
<b>CO5</b>	M	H	M									M	M	M	
<b>CO6</b>	H	H	H									M	H	H	
<b>16LOEX14</b>	M	H	M									M			

**L-Low, M-Moderate(medium), H-High**





16NOEX15

**INDUSTRIAL AUTOMATION SYSTEMS**

**CATEGORY: OE**

*(Common to all Branches)*

**Pre-Requisite: Nil**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

- To elaborate the basic concept of automation and the components required for automation.
- To introduce the concept and programming of programmable logic controllers and distributed control system which is used for process automation.
- To outline the basic concepts of SCADA technology.

**UNIT- I INTRODUCTION TO AUTOMATION**

**9**

Automation overview – requirement of automation systems – architecture of industrial automation system – power supplies and isolators –relays – switches –transducers – sensors – seal-in circuits – industrial bus systems : modbus and profibus.

**UNIT - II AUTOMATION COMPONENTS**

**9**

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**

PLC Hardware – 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 (DCS)**

**9**

Overview of DCS – DCS hardware – DCS software configuration – DCS communication – DCS supervisory computer tasks – DCS integration with PLC and Computers

**UNIT - V SCADA**

**9**

Introduction - Supervisory Control and Data Acquisition Systems (SCADA) – SCADA HMI Essentials – SCADA Components – SCADA Configuration and Software – HMI hardware and software.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

**Text Books:**

1. John.W. Webb Ronald A Reis, “*Programmable Logic Controllers - Principles and Applications*”, Prentice Hall Inc., 5<sup>th</sup> Edition, 2003.
2. M. P. Lukcas, “*Distributed Control Systems*”, Van Nostrand Reinhold Co., 1986.

**Reference Books:**

1. Bela G Liptak, “*Process software and digital networks – Volume 3*”, 4<sup>th</sup> Edition, CRC press, 2012.
2. Frank D. Petruzella, “*Programmable Logic Controllers*”, 5<sup>th</sup> Edition, McGraw Hill, 2016.
3. Huges T, “*Programmable Logic Controllers*”, ISA press, 1994
4. Romily Bowden, “*HART application guide and the OSI communication foundation*”, 1999
5. Krishna Kant, “*Computer Based Industrial Control*” Second edition, Prentice Hall of India, New Delhi, 2010

**COURSE OUTCOMES:**

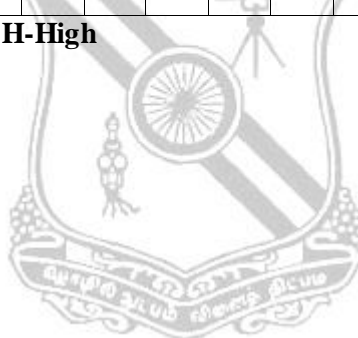
On completion of this course, the students will be able to

- CO1:** Elaborate the basic architecture of automation systems
- CO2:** Describe the various sensors and actuators involved in industrial automation
- CO3:** Construct ladder logic diagram using PLC basic functions, timer and counter functions for simple applications
- CO4:** Illustrate the functional components and supervisory control of DCS with relevant diagrams.
- CO5:** Describe the basics of SCADA technology

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L
<b>CO2</b>	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
<b>CO3</b>	H	H	M	M	L	L	M	H	L	M	L	L	H	L	L
<b>CO4</b>	H	H	H	H	L	L	L	H	L	M	L	L	H	L	L
<b>CO5</b>	H	H	M	M	M	L	L	H	L	M	L	L	H	L	L
<b>16NOEX15</b>	H	H	M	M	L	L	L	H	L	M	L	L	H	L	L

**L-Low, M-Moderate (medium), H-High**



16NOEX16

**MEASUREMENTS AND INSTRUMENTATION**

**CATEGORY:OE**

*(Common to all Branches)*

**Pre-Requisite:** Nil

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

- To study about the electrical parameter measuring instruments.
- To familiarize about the measurement techniques for power and energy.
- To gain knowledge about potentiometer and instrument transformers.
- To learn about the working of different analog and digital instruments.
- To study about display and recording devices.

**UNIT - I MEASUREMENT OF ELECTRICAL PARAMETERS**

**9**

Types of ammeters and voltmeters: PMMC Instruments, Moving Iron Instruments, Dynamometer type Instruments – Resistance measurement: Wheatstone bridge, Kelvin double bridge and Direct deflection methods. Measurement of Inductance: Maxwell-Wien Bridge, Hay’s bridge and Anderson Bridge - Measurement of Capacitance: Schering Bridge.

**UNIT - II POWER AND ENERGY MEASUREMENTS**

**9**

Electro-dynamic type wattmeter: Theory and its errors – LPF wattmeter – Phantom loading – Single phase Induction type energy meter – 3 phase induction energy meter and phase measurement– Calibration of wattmeter and Energy meters – Synchroscope.

**UNIT - III POTENTIOMETERS AND INSTRUMENT TRANSFORMERS**

**9**

D.C. Potentiometers: Student type potentiometer, Precision potentiometer – A.C. Potentiometers: Polar and Coordinate types – Applications – Instrument Transformer: Construction and theory of Current Transformers and Potential Transformers.

**UNIT - IV ANALOG AND DIGITAL INSTRUMENTS**

**9**

Wave analyzers – Signal and function generators – Distortion factor meter – Q meter – Digital voltmeter and multi-meter – Microprocessor based DMM with auto ranging and self diagnostic features – Frequency measurement.

**UNIT - V DISPLAY AND RECORDING DEVICES**

**9**

Cathode ray oscilloscope: Classification, Sampling and storage scopes – LED, LCD and dot matrix displays – X-Y recorders – Magnetic tape recorders –Digital Data Recording –Digital memory waveform recorder – Data loggers.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil Total:45 Periods

**Text Books:**

1.Kalsi. H.S, “*Electronic Instrumentation*”, Tata McGraw-Hill, New Delhi, 2010

2.Sawhney.A.K, “*A Course in Electrical & Electronic Measurements & Instrumentation*”, Dhanpat Rai and Co., New Delhi, 2010

**Reference Books:**

1. Northrop. R.B, “*Introduction to Instrumentation and Measurements*”, Taylor & Francis, New Delhi, 2008.
2. Carr.J.J, “*Elements of Electronic Instrumentation and Measurement*”, Pearson Education India, New Delhi, 2011.
3. David A.Bell, “*Electronic Instrumentation and Measurements*”, PHI, New Delhi.
4. Copper. W.D and Hlefrick.. A.D, “*Modern Electronic Instrumentation and Measurement Technique*” 5<sup>th</sup> Edition, Prentice Hall of India, 2002.

**COURSE OUTCOMES:**

On completion of this course, the students will be able to

- CO1:** Compare the working principles, merits and demerits of different types of electrical instruments and can understand about different instruments that are used for Measurement .
- CO2:** Understand how different bridge networks are constructed and balanced for finding the values of resistance, capacitance and inductance.
- CO3:** Apply knowledge of electronic instrumentation for measurement of electrical quantities.
- CO4:** Apply the principles and practices for instrument design and development to real world problems.
- CO5:** Select a suitable measuring instrument for a given application.
- CO6:** Pursue higher studies and do research activities in the field of measurement and instrumentation.

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	H	H	M	H	M	H	M	L	H	M	H	H	H	M	H
<b>CO2</b>	H	M	M	M	H	H	H	M	H	L	H	H	H	H	M
<b>CO3</b>	H	H	M	H	M	H	M	L	H	M	H	H	H	H	H
<b>CO4</b>	H	H	M	H	M	H	M	L	H	M	H	H	H	M	H
<b>CO5</b>	H	H	M	H	M	H	M	L	H	M	H	H	H	M	M
<b>CO6</b>	H	H	M	H	M	H	M	L	H	M	H	H	M	H	M
<b>16NOEX16</b>	H	H	M	H	M	H	M	L	H	M	H	H	M	H	M

**L-Low, M-Moderate (medium), H-High**

**16SOEX17**

**ENTERPRISE JAVA**  
(Common to all Branches)

**CATEGORY: OE**

**Pre-Requisite: Nil**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES**

Upon completion of this course, the students will be familiar with:

- Basic programming constructs in java to develop simple object oriented programs
- Enterprise Architecture types and features of Java EE platform
- JEE foundation concepts like Enterprise java bean, JSP and JSF
- Distributed Programs and methods to connect with database.
- Java Web services

**UNIT - I INTRODUCTION TO JAVA**

**9**

Introduction to object oriented programming-Features of Java – Data types, variables and arrays – Operators – Control statements – Classes and Methods – Inheritance. Packages and Interfaces – Exception Handling – Multithreaded Programming – Input/Output – Files – Utility Classes – String Handling – Networking –Applet class – Event Handling.

**UNIT -II INTRODUCTION TO ENTERPRISE JAVA**

**9**

Challenges of Enterprise application Development - Platform for enterprise Solutions – J2EE Application Scenario - J2EE Platform Technologies –J2EE Multi-Tier Architecture - J2EE Architecture Approaches - Model-View-Controller Architecture - J2EE Design Patterns - Designing the Sample Application - Choosing Application Tiers - Choosing Local or Distributed Architecture - Architecture of the Sample Application

**UNIT- III ENTERPRISE JAVA FOUNDATION**

**9**

Enterprise Java Beans -Business Logic and Business Objects. - Enterprise Beans as J2EE Business Objects - Entity Beans - Session Beans - Message-Driven Beans -Transaction support in EJB-Security support in EJB –Java Server Pages - Directive Elements - Scripting Elements - Action Elements-Expression Language-JSP Standard Tag Library - Java Server Page Online Store –Java Server Faces - Life Cycle - Resource Management.

**UNIT -IV INTERCONNECTIVITY**

**9**

Concept of JDBC – JDBC Driver types- Database Connection – Associating JDBC Bridge with the database – Statement Objects –Resultset – Transaction Processing – RMI- Network File-Locking Server -Java Mail API and Java Activation Framework – send , receive, retrieve and delete email message - Java Message Service – JMS Fundamentals –Components of a JMS program -JMS architecture –JMS-Based Alarm System - JNDI – Naming and Directories – Naming Operations.

**UNIT -V WEB SERVICES**

**9**

SOAP Basics – Java API for XML Messaging – Creating a SOAP Attachment – Accessing a SOAP Attachment – Universal Description, Discovery and Integration (UDDI)- UDDI Architecture – UDDI Application Programming Interface – Inquiry Application Programming Interface – Publishing Application Programming Interface –JAXR – JAXR client – Publishing a service to an XML Registry – Removing a published service from an XML Registry- WSDL – Inside WSDL- WSDL and SOAP - RESTful Web services – REST Approach - Java API for RESTful Web service.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

### Text Books

1. Herbert Schildt, “Java The Complete Reference” , 9th Edition. Tata McGraw- Hill Edition. 2014.
2. Stephen Asbury and Scott R. Weiner “Developing Java Enterprise Applications”, second edition Wiley Publishing. 1999.
3. Antonio Goncalves “Beginning Java™ EE 6 Platform with GlassFish™ 3 From Novice to Professional” Apress 2009.
4. Jim Keogh, “The Complete Reference J2EE ” ,Tata McGraw –Hill 2002

### Reference Books

1. John Brock, Arun Gupta, Geertjan Wielenga “Java Server Programming Java EE 7 (J2EE 1.7) - Black Book” McGraw Hill, 2015.
2. Inderjeet Singh, Beth Stearns, Mark Johnson, and the Enterprise Team “Designing Enterprise Applications with the J2EE™ Platform”, Second Edition, Addison Wesley, 2002.

### COURSE OUTCOMES:

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

- CO1:** Write simple java programs using fundamental concepts of java like control structures, inheritance, packages, interfaces, multithreaded programming and exception handling. [Usage]
- CO2:** Write java program for Networking using applets. [Usage]
- CO3:** Describe and use the client/server and distributed architectures in a programming environment. [Usage]
- CO4:** Use EJB, JSP and JFC technology in developing enterprise applications [Usage]
- CO5:** Apply Java interconnectivity techniques like JDBC, RMI, Java Mail, JMS , JNDI in developing enterprise applications. [Usage]
- CO6:** Explain the roles XML, JAXR, SOAP, WSDL and UDDI in the architecture of Web services [Familiarity]
- CO7:** Develop java program to use RESTful web services [Assessment].

### COURSE ARTICULATION MATRIX:

CO	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	PSO 4
CO1	H	L	H	L	H		L					M	L	H	L	H
CO2	H	M	H	M	H		L					M	M	H	L	H
CO3	H	L	H	L	H		L					M	L	H	H	H
CO4	M	L	M	L	H		L					M	M	H	H	H
CO5	H	L	H	L	H		M					M	L	H	H	H
CO6	M	L	M	L	H		L					L	M	H	H	H
CO7	H	L	H	L	H		M					M	M	H	H	H
16SOEX17	H	L	H	L	H		L					M	M	H	H	H

L-Low, M-Moderate(medium), H-High

16SOEX18

**CYBER SECURITY**  
(Common to all Branches)

**CATEGORY:OE**

**Pre-Requisite: Nil**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

Upon completion of this course, the students will be familiar with:

- Cybercrime and cyber offenses.
- Cybercrime using mobile devices.
- Tools and methods used in cybercrime.
- Legal perspectives of cybercrime.
- Fundamentals of computer forensics.

**UNIT - I INTRODUCTION TO CYBERCRIME AND CYBEROFFENSES 9**

Cybercrime and Information Security - Classifications of Cybercrimes - The Legal Perspectives - Cybercrime and the Indian ITA 2000 - A Global Perspective on Cybercrimes - Plan of Attacks - Social Engineering – Cyberstalking - Cybercafe and Cybercrimes – Botnets - Attack Vector.

**UNIT - II CYBERCRIME: MOBILE AND WIRELESS DEVICES 9**

Proliferation of Mobile and Wireless Devices - Trends in Mobility - Credit Card Frauds in Mobile and Wireless Computing Era – Security challenges posed by mobile devices – registry setting for mobile devices – authentication service security – attacks on mobile/cell phones – Organizational measures for handling mobiles.

**UNIT -III TOOLS AND METHODS USED IN CYBERCRIME 9**

Proxy Servers and Anonymizers – Phishing - Password Cracking – Keyloggers – Spywares -Virus and Worms - Trojan Horses and Backdoors – Steganography - DoS and DDoS Attacks - SQL Injection - Attacks on Wireless Networks.

**UNIT - IV CYBERCRIMES AND CYBERSECURITY: THE LEGAL PERSPECTIVES 9**

Cyberlaws- The Indian Context - The Indian IT Act - Challenges to Indian Law and Cybercrime Scenario in India - Consequences of Not Addressing the Weakness in Information Technology Act - Digital Signatures and the Indian IT Act - Amendments to the Indian IT Act - Cybercrime and Punishment.

**UNIT -V UNDERSTANDING COMPUTER FORENSICS 9**

Digital Forensics - Forensics Analysis of E-Mail - Network Forensics - Forensics and Steganography - Forensics and Social Networking Sites - Challenges in Computer Forensics - Data Privacy Issues – Forensics Auditing – Antiforensics.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :nil

Practical: nil

Total:45 Periods

**Text Book:**

1.Nina Godbole and SUNIT - Belapur, “Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley India Publications, April, 2011

**Reference Books:**

1. Robert Jones, “Internet Forensics: Using Digital Evidence to Solve Computer Crime”, O’Reilly Media, October, 2005.
2. Chad Steel, “Windows Forensics: The field guide for conducting corporate computer investigations”, Wiley India Publications, December, 2006.

**COURSE OUTCOMES:**

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

**CO1:** Explain the fundamental concepts of cybercrime and cyberoffenses. **[Familiarity]**

**CO2:** Describe the cybercrimes occurred in mobile and wireless devices. **[Familiarity]**

**CO3:** Elaborate the methods used in cybercrime. **[Familiarity]**

**CO4:** Explain the laws for cybercrime and its respective punishments. **[Familiarity]**

**CO5:** Explain the forensics Analysis of E-Mail, Network and Social Networking Sites. **[Familiarity]**

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	M	M	M	M	L	H	L	M				H	H	L	M
<b>CO2</b>	M	M	M	M	M	H	M	M				M	H	H	M
<b>CO3</b>	H	L	L	L	L	H	H	L				H	H	H	L
<b>CO4</b>	H	M	M	M	M	H	H	H				M	H	H	L
<b>CO5</b>	H	M	M	M	M	L	H	L				H	H	H	M
<b>16SOEX18</b>	H	M	M	M	M	H	H	M				H	H	H	M

**L-Low, M-Moderate(medium), H-High**



**16SOEX19**

**NETWORK ESSENTIAL**  
(Common to all Branches)

**CATEGORY:OE**

**Pre-Requisite: Nil**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

Upon completion of this course, the students will be familiar with:

- Basic taxonomy and terminology of the computer networking
- Wireless networking
- Addressing and Routing
- Routing protocols
- Troubleshooting and security issues.

**UNIT -I INTRODUCTION**

**9**

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**

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**

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**

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**

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 :Nil

Practical: Nil

Total:45 Periods

**Text Books:**

- 1.Jeffrey S.Beasley Piyasat Nilkaew, “**Network Essentials**”, 3<sup>rd</sup> Edition, Pearson, 2012.
- 2.Larry L. Peterson and Bruce S. Davie, “**Computer Networks, A Systems Approach**”, Morgan Kaufmann Publishers Inc, 5<sup>th</sup> edition 2011.

**Reference Books:**

- 1.Behrouz A.Ferouzan, “Data Communications and Networking”, 5<sup>th</sup> edition, Tata McGraw-Hill, 2012.
- 2.Andrew S. Tanenbaum, “Computer networks”, PHI, 5th edition 2011.

**COURSE OUTCOMES:**

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

- CO1:** Identify topologies and types of Computer Networks [**Familiarity**]
- CO2:** Enumerate the layers of the OSI model and TCP/IP and Explain the functions of each layer [**Familiarity**]
- CO3:** Identify and Compare types of cabling for data communication [**Usage**]
- CO4:** Explain the significance of wireless networks [**Familiarity**]
- CO5:** Configure a Wireless LAN [**Assessment**]
- CO6:** Configure router and a switch [**Assessment**]
- CO7:** Describe basic routing algorithms and network services. [**Usage**]
- CO8:** Troubleshoot the router and switch interface [**Usage**]
- CO9:** Analyze Campus Network data traffic [**Usage**]

**COURSE ARTICULATION MATRIX:**

CO/ PO	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	PSO 4
<b>CO1</b>	M	M	H	H	H	L	L	H	H	H	H	H	M	H	H	M
<b>CO2</b>	H	H	H	H	H	L	L	H	H	H	H	H	M	H	H	H
<b>CO3</b>	L	L	L	L	H	L	L	H	L	L	L	H	M	H	H	L
<b>CO4</b>	L	H	M	M	H	L	L	H	H	M	L	H	L	H	H	L
<b>CO5</b>	H	H	H	M	H	L	L	H	H	H	M	H	M	H	H	H
<b>CO6</b>	H	H	H	M	H	L	L	H	H	M	L	H	M	H	H	H
<b>CO7</b>	H	H	H	H	H	L	L	H	H	H	M	H	M	H	H	H
<b>CO8</b>	H	H	H	H	H	L	L	H	H	M	L	H	M	H	H	H
<b>CO9</b>	H	H	H	H	H	L	L	H	H	H	M	H	M	H	H	H
<b>16SOEX19</b>	M	H	H	M	H	L	L	H	H	L	M	H	M	H	H	M

**L-Low, M-Moderate (medium), H-High**

16IOEX20

**PROGRAMMING IN PYTHON**

**CATEGORY:OE**

*(Common to all Branches)*

**Pre-Requisite: Nil**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

Upon completion of this course the students will be Familiar with:

- Data types and variables declaration
- Control statements, Functions and the use of basic programming.
- List, dictionary and functions used in python.
- File and Exception handling.
- Object oriented programming and GUI development.

**UNIT -I INTRODUCTION**

**9**

Introduction to Python - Setting up Python in OS – Python IDLE(write- edit- run- and save programs) – Strings - Numbers – Variables – simple I/O - Getting user input– Using String method–Converting values.

**UNIT -II CONTROL STATEMENTS AND FUNCTIONS**

**9**

Control statements – Random number generator- Branching and loops – Range functions- Functions – User defined functions- passing parameters- return function- working with global variables and constants.

**UNIT -III LISTS AND DICTIONARIES**

**9**

Lists – create- index- slice a list- Add and delete elements from a list- Append- Sort and reverse a list- nested sequences- Dictionaries – Create- add- delete from a Dictionary- Operations associated with pairs of data.

**UNIT -IV FILES AND EXCEPTIONS**

**9**

Files – Read from text files- Write to text files- Read and write more complex data- Exceptions – Intercept and handle errors during program’s execution.

**UNIT -V OBJECT ORIENTED PROGRAMMING AND GUI**

**9**

Object oriented programming – Create objects of different classes in the same program- objects communication- complex object creation- derive new classes- existing class extension- override method- GUI – GUI toolkit- create and fill frames- create buttons- text entries and text boxes- create check buttons and radio buttons - case study – create a web page using GUI functionality.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

**Text Books:**

1.Y. Daniel Liang“**Introduction to Programming Using Python**”, Pearson, 2013.

2.Charles Dierbach“**Introduction to Computer Science Using Python: A Computational Problem- Solving Focus**”, Wiley Publications, 2012.

**Reference Books:**

1.Michael Dawson “**Python Programming for the Absolute Beginner**”, Premier Press, 2003.

**COURSE OUTCOMES:**

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

**CO1:** Use various data types.[**Understand**]

**CO2:** Handle the arrangement of data elements in Lists and Dictionary structures.[**Analyze**]

**CO3:** Use control statements and functions. [**Understand**]

**CO4:** Handle exceptions and perform file operations. [**Understand**]

**CO5:** Develop application using object oriented programming and GUI. [**Analyze**]

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	M	L		L	L		L	L			L	L	L	L
<b>CO2</b>	M	L		L	L		L	L			L	L	L	L
<b>CO3</b>	M	M	L	M	L		L	L			L	L	M	L
<b>CO4</b>	M	M	L	M	L		M	M			L	L	M	L
<b>CO5</b>	M	M	L	M	L		M	M			M	L	M	L
<b>16IOEX20</b>	M	M	L	M	L		L	L			L	L	M	L

**L-Low, M-Moderate(medium), H-High**



16IOEX21

**BIG DATA SCIENCE**  
(Common to all Branches)

**CATEGORY:OE**

**Pre-Requisite: Nil**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

Upon completion of this course, the students will be familiar with,

- Big Data and its characteristics
- Technologies used for Big Data Storage and Analysis
- Mining larger data streams
- Concepts related to Link analysis and handle frequent data sets

**UNIT - I THE FUNDAMENTALS OF BIG DATA**

**9**

Understanding Big Data-Concepts and Technology-Big Data Characteristics-Types of data-Case Study-Business Motivation and Drivers for Big Data Adoption- Planning Considerations-Enterprise Technologies and Big Data Business Intelligence- OLTP-OLAP-Extract Transform Load-Data Warehouses-Data Mart-Traditional and Big Data BI-Case Study.

**UNIT - II BIG DATA STORAGE AND PROCESSING**

**9**

Big Data Storage Concepts- Clusters-File systems and Distributed File Systems-NoSQL- Sharding - Replication -Sharding and Replication-CAP Theorem-ACID-BASE-Case Study- Big Data Processing Concepts- Parallel Data Processing-Distributed Data Processing-Hadoop-Processing Workloads-Cluster-Processing in Batch mode-Processing in RealTime mode-Case study.

**UNIT - III BIG DATA STORAGE AND ANALYSIS TECHNOLOGY**

**9**

Big Data Storage Technology: On-Disk Storage devices-NoSQL Databases-In-Memory Storage Devices-Case study, Big Data Analysis Techniques: Quantitative Analysis-Qualitative Analysis-Data Mining-Statistical Analysis-Machine Learning-Semantic Analysis-Visual Analysis-Case Study.

**UNIT - IV MINING DATA STREAMS**

**9**

The stream data model – Sampling data streams – counting distinct elements in a stream – Estimating moments. Finding similar items – Applications of nearest neighbor search – shingling of documents - similarity preservation – locality sensitive hashing-distance measures – methods for high degree similarity.

**UNIT - V LINK ANALYSIS AND FREQUENT ITEMSETS**

**9**

Link analysis – Page rank – Efficient computation of a page rank – topic sensitive page rank – link spam –Frequent datasets – the market basket model – A-Priori algorithm – handling larger datasets in main memory –limited pass algorithm – counting frequent items in a stream.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

**Text Books:**

1.Thomas Erl, WajidKhattak, and Paul Buhler, “**Big Data Fundamentals Concepts, Drivers & Techniques**”, Prentice Hall,2015

2.Anand Rajaraman and Jeffrey David Ullman, “**Mining of Massive Datasets**”, Cambridge University Press, 2012.

**Reference Books:**

1. Paul Zikopoulos, Chris Eaton, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data”, McGraw Hill, 2011.
2. Frank J Ohlhorst, “Big Data Analytics: Turning Big Data into Big Money”, Wiley and SAS Business Series, 2012.

**COURSE OUTCOMES:**

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

**CO1:** Understand the Big Data and usage in Enterprise Technologies. [Understand]

**CO2:** Store and Process Big Data using suitable Processing Methods [Understand]

**CO3:** Handle Big Data using appropriate analysis Techniques. [Analyse]

**CO4:** Mine larger data streams using suitable algorithms. [Understand]

**CO5:** Rank pages and handle large data sets efficiently [Analyse]

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
CO1	H	L	M	L	H	L		L				M	H	L
CO2	M	M	M	L	H	L		L				M	M	L
CO3	M	H	M	L	H	L		L				L	H	L
CO4	M	H	M	L	M	L		L				M	H	L
CO5	L	M	H	L	L	L		L				L	H	L
16IOEX21	M	M	M	L	M	L		L				M	H	L

**L-Low, M-Moderate (medium), H-High**

**16IOEX22 OBJECT ORIENTED PROGRAMMING USING C++ CATEGORY:OE**  
*(Common to all Branches)*

**Pre-Requisite: Nil**

L T P C

**COURSE OBJECTIVES:**

3 0 0 3

Upon completion of this course, the students will be familiar with,

- Fundamentals of object oriented programming
- Classes and objects
- Concepts of overloading and type conversions
- Inheritance and Polymorphisms
- Files, templates and exception handling

**UNIT - I PRINCIPLES OF OBJECT ORIENTED PROGRAMMING 9**

Basic concepts- benefits – applications of object oriented programming – beginning with C++ - tokens – expressions and control structures – C++ stream classes – Formatted and Unformatted I/O operations. Managing output with manipulators.

**UNIT - II CLASSES AND OBJECTS 9**

Introduction – specifying class – defining member functions – memory allocation constructors and destructors:- parameterized- copy – default -dynamic and multiple constructors – destructors.

**UNIT - III FUNCTIONS AND TYPE CONVERSIONS 9**

Introduction – function prototyping call by reference – return by reference – inline function – recursion – friend function – function overloading – operator overloading – manipulation of strings using operators – type conversions.

**UNIT - IV INHERITANCE AND POLYMORPHISM 9**

Defining derived classes – single, multiple, multilevel, hierarchical and hybrid inheritance – virtual base classes – abstract base classes – nesting of classes - pointers – pointers to objects – this pointer – pointers to derived classes – virtual functions – pure virtual functions virtual constructors and destructors.

**UNIT - V FILES AND TEMPLATES 9**

Classes for file stream operations – opening and closing a file – detecting EOF – open file modes – file pointers and their manipulations – sequential I/O operations – updating and error handling of file. Class and function template – template with multiple parameters – overloading, member function and non-type template arguments-Exception handling.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

**Text Book:**

1.E.Balagurusamy “**Object oriented Programming with C++**” McGraw Hill Education Ltd,6<sup>th</sup> Edition 2013.

**Reference Books:**

- 1.R.Rajaram “**Object Oriented Programming and C++**” New Age International 2nd edition , 2013
- 2.K.R. Venugopal,Rajkumar,T. Ravishankar “**Mastering C++**” , Tata McGraw Hill Education,2<sup>nd</sup> edition, 2013
- 3.Yashavant P. Kanetkar “ **Let us C++**” BPB Publications , 2nd edition 2003.

## COURSE OUTCOMES

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

**CO1:** Understand the principles of object oriented programming [Understand]

**CO2:** Develop programs using classes and objects.[Analyze]

**CO3:** Use functions and type conversions in programs. [Understand]

**CO4:** Apply inheritance and polymorphism to develop applications. [Analyze]

**CO5:** Use files, templates and handle exceptions. [Understand]

## COURSE ARTICULATION MATRIX:

CO/ PO	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
<b>CO1</b>	M	H	H	M	M		M	M				M	M	M
<b>CO2</b>	M	H	H	H	M		M	M				M	H	M
<b>CO3</b>	M	H	H	H	M		M	M				M	H	M
<b>CO4</b>	M	H	H	H	M	L	M	M				M	H	M
<b>CO5</b>	M	H	H	H	M		M	M				M	H	M
<b>16IOEX22</b>	M	H	H	H	M	L	M	M				M	H	M

**L-Low, M-Moderate (medium), H-High**





16BOEX23

**COMPUTATIONAL BIOLOGY**  
(Common to all Branches)

**CATEGORY : OE**

**Pre-Requisite: Nil**

L	T	P	C
3	0	0	3

**COURSE OBJECTIVES:**

- Understand the basic concepts and role of computation in biological analysis
- Familiarize with sequence alignment methods
- Understand the machine learning tools used for biological analysis

**UNIT -I BASICS OF BIOLOGY**

**9**

Biomolecules of life: Structure and Composition of DNA, RNA & Protein. Protein Structure basics-Primary, Secondary and tertiary Structure of protein

**UNIT -II BIOLOGICAL DATABASES**

**9**

Concept of Relational database, Data archiving, Data mining, Primary databases-NCBI, EMBL, DDBJ; Structure databases-PDB

**UNIT -III SEQUENCE ANALYSIS**

**9**

Pairwise alignment tools-Dot matrix analysis, Dynamic programming-Smith waterman and Needleman Wunsch algorithm, Heuristic methods- BLAST, FASTA; Multiple sequence alignment methods-Progressive alignment(Clustal)

**UNIT -IV STRUCTURE ANALYSIS AND DRUG DESIGN**

**9**

Protein secondary prediction-Chou Fasman method, GOR method; Tertiary structure prediction-Homology modelling, Introduction to Computer aided drug design.

**UNIT -V MACHINE LEARNING**

**9**

Genetic Algorithm, Neural networks, Artificial Intelligence, Hidden Markov model -application in bioinformatics.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial : Nil

Practical: Nil

Total:45 Periods

**Text Books:**

1. David W. Mount, "**Bioinformatics: Sequence and Genome Analysis**", Cold Spring Harbor Laboratory Press, Second Edition, 2004.
2. Arthur M. Lesk, "**Introduction to Bioinformatics**", Oxford University Press, 2008.
3. Pierre Baldi, Soren Brunak, "**Bioinformatics: The machine learning approach**" MIT Press, 2001

**Reference Books:**

1. Andrew R. Leach, "**Molecular Modeling Principles And Applications**", Second Edition, Prentice Hall, 2001.
2. Baxevanis A.D. and Oullette, B.F.F, "**A Practical Guide to the Analysis of Genes and Proteins**", 2nd ed., John Wiley, 2002
3. David L. Nelson, Michael M. Cox, "**Lehninger Principles of Biochemistry**", Sixth edition, Freeman, W. H. & Co. Publisher, 2012.

## COURSE OUTCOMES:

Upon completion of the Computational Biology course, the students will be able to

**CO1:** Understand basic structure of Biological macromolecules

**CO2:** Acquire the knowledge of biological databases

**CO3:** Ability to perform pair wise and multiple sequence alignment

**CO4:** Ability to predict the secondary and tertiary structure of proteins.

**CO5:** Understand the machine learning approaches in computational biology

## COURSE ARTICULATION MATRIX:

CO/ PO	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
<b>CO1</b>	M	M	L	L	M	L	L		M			L	M	M	L
<b>CO2</b>	M	L	L	L	M	M	L		L			L	M	M	L
<b>CO3</b>	L	L	L	M	M	M	L		L			L	L	M	L
<b>CO4</b>	M	M	L	M	M	M	L		L			L	M	M	L
<b>CO5</b>	M	M	L	H	H	M	L		M			L	M	H	L
<b>16BOEX23</b>	M	M	L	M	M	M	L		L			L	M	M	L

**L-Low, M-Moderate (medium), H-High**



16BOEX24

**BIOLOGY FOR ENGINEERS**  
(Common to all Branches)

**CATEGORY:OE**

L	T	P	C
3	0	0	3

**Pre-Requisite: Nil**

**COURSE OBJECTIVES:**

To enable the students

- To understand the basic functions of the cell and their mechanisms in transport process
- To get familiarize human anatomy and physiology
- To learn about microbes, immune system and biomolecules
- To know the concepts of applied biology

**UNIT -I BASICS OF CELL BIOLOGY**

**9**

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**

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**

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**

Introduction to Biochemistry, Classification, structure and properties of carbohydrates, proteins, lipids and nucleic acids. Innate and acquired immUNIT -y, Types of immune responses.

**UNIT -V APPLIED BIOLOGY FOR ENGINEERS**

**9**

Overview of biosensors- glucometer applications-medicine, Microarray analysis to diagnose the cancer, Microbial production of biofuels, Applications of stem cells.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

**Text Books:**

1.Darnell J, Lodish H, Baltimore D, “**Molecular Cell Biology**”, W.H.Freeman; 8<sup>th</sup> edition,2016

2.Pelczar MJ, Chan ECS and KreinNR,“**Microbiology**”, Tata McGraw Hill, 5th edition, New Delhi.2001.

3.WulfCruger and AnnelieseCruger, “**A Textbook of Industrial Microbiology**”, Panima Publishing Corporation, 2<sup>nd</sup> Edition, 2000.

**Reference Books:**

1. David L. Nelson and Michael M Cox, “Lehninger’s Principles of Biochemistry”, Macmillan Worth Publisher, 4<sup>th</sup> edition, 2004.
2. Brain R. Eggs, “Chemical Sensors and Biosensors”, John Wiley & Sons, 2002
3. Anton Moser, “Bioprocess Technology, Kinetics and Reactors” Springer, Berlin (Verlag), 1998
4. Kuby J, “Immunology”, WH Freeman & Co., 2000.

**COURSE OUTCOMES:**

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

**CO1:** Understand the functions of cell and their structural organization

**CO2:** Describe the mechanisms and role of cell in immune system

**CO3:** Get familiarized biomolecules and human anatomy system

**CO4:** Illustrate the applications of microbes in industrial process

**CO5:** Apply the engineering concepts in biology

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	L	L	L		L	M	M	L		L	M	L	L	L	L
<b>CO2</b>	L	L	L	L	L	M	M	L	L	L	L	L	L	L	L
<b>CO3</b>	L	L	L		L	L	L	L	L	L	L	L	L	L	L
<b>CO4</b>	L	L	L	L	L	M	L	L		L	L	L	L	M	L
<b>CO5</b>	L	L	L	L	L	M	M	L	L	L	L	L	L	L	L
<b>16BOEX24</b>	L	L	L	L	L	M	M	L	L	L	L	L	L	L	L

**L-Low, M-Moderate(medium), H-High**

16BOEX25

**FUNDAMENTALS OF BIO ENGINEERING**

**CATEGORY:OE**

*(Common to all Branches)*

L T P C

**Pre-Requisite: Nil**

3 0 0 3

**COURSE OBJECTIVES:**

- To make the students aware of the overall industrial bioprocess.
- To understand the basic configuration and parts of a fermentor.
- To study the production of primary and secondary metabolites.
- To understand the production of modern biotechnology products.

**UNIT - I INTRODUCTION TO INDUSTRIAL BIOPROCESS**

**9**

Fermentation - Bacterial, Fungal and Yeast, Biochemistry of fermentation. Traditional and Modern Biotechnology - A brief survey of organisms, processes, products. Basic concepts of Upstream and Downstream processing in Bioprocess.

**UNIT - II FERMENTATION INDUSTRY**

**9**

Overview of fermentation industry, Basic configuration of Fermentor and ancillaries, main parameters to be monitored and controlled in fermentation processes. Types of fermentation – Solid state, submerged, batch, continuous, fed batch fermentation methods.

**UNIT - III PRODUCTION OF PRIMARY METABOLITES**

**9**

A brief outline of processes for the production of some commercially important organic acids - Citric acid, lactic acid, acetic acid; amino acids - glutamic acid, phenylalanine; ethanol.

**UNIT - IV PRODUCTION OF SECONDARY METABOLITES**

**9**

Study of production processes for various classes of secondary metabolites: Antibiotics: beta lactams – penicillin and cephalosporin; aminoglycosides – streptomycin; macrolides - erythromycin, vitamin - B9, B12

**UNIT - V PRODUCTS THROUGH MODERN BIOTECHNIQUES**

**9**

Production of industrial enzymes - proteases, amylases, lipases; Production of single cell protein from wastes; biopreservatives – Bacterosin; biopolymers - xanthan gum and PHA. Industrial uses of enzymes in detergents, beverage and food.

**CONTACT PERIODS**

Lecture : 45 Periods

Tutorial :Nil

Practical: Nil

Total:45 Periods

**Text Books:**

- 1.Peter F. Stanbury, Stephen J. Hall & A. Whitaker, “**Principles of Fermentation Technology**”, Science & Technology Books. 1995.
- 2.Presscott, S.C. and Cecil G. Dunn, “**Industrial Microbiology**”, Agrobios (India), 2005.
- 3.Casida, L.E. “**Industrial Microbiology**”, New Age International (P) Ltd, 1968.

**Reference Books:**

1. Crueger, W and Anneliese Crueger, *Biotechnology: “A Textbook of Industrial Microbiology”*, Panima Publishing Corporation, Edition 2, 2003
2. Sathyanarayana, U., *“Biotechnology”*, Books and Allied (P) Ltd. Kolkata, 2005
3. Ratledge C and Kristiansen B. *“Basic Biotechnology”*, Cambridge University Press, second Edition, 2001.
4. Michael J. Waites. *“Industrial Microbiology: An Introduction”*, Blackwell Publishing, 2001.

**COURSE OUTCOMES:**

- CO1:** Upon completion of the course in Bioprocess Principles graduates will be able to understand the basics of industrial bioprocess.
- CO2:** Explain the principle of a fermentation process and the chronological development of fermentation industry.
- CO3:** Understand the basic configuration of a fermentor and its ancillaries.
- CO4:** Learn the production of various primary and secondary metabolites.
- CO5:** Understand the production of biotechnological products.

**COURSE ARTICULATION MATRIX:**

CO/ PO	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
<b>CO1</b>	M	H	H		M							M	M	M	M
<b>CO2</b>	H	M			M	L						M	H	M	M
<b>CO3</b>	H	H	H		M	M		L				M	H	M	M
<b>CO4</b>	H	L	L		M	L		L				M	H	M	M
<b>CO5</b>	H	M	H		M	L		L				M	H	M	M
<b>16BOEX25</b>	H	M	M		M	L		L				M	H	M	M

**L-Low, M-Moderate (medium), H-High**

16NOC1Z1

HUMAN VALUES – I

CATEGORY: OC

Pre- Requisite : NIL

L	T	P	C
1	0	0	1

### COURSE OBJECTIVES

- Essential complementarity between ‘values’ and ‘skills’ to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- The development of a Holistic perspective among students towards life, profession and happiness based on correct understanding of the Human reality and the rest of existence, which forms the basis of Value based living in a natural way.
- The plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually satisfying human behaviour and mutually enriching interaction with nature.

### UNIT-I INTRODUCTION TO VALUE EDUCATION 5

Introduction–Need, Basic Guidance, Content and Process for Value Education-Basic human Aspirations-Prosperity and happiness-Methods to fulfil human aspirations-Understanding and living in harmony at various levels.

### UNIT - II HARMONY IN THE HUMAN BEING 5

Coexistence - Happiness and convenience - Appraisal of Physical needs - Mental and Physical health - Human relationship - Mutual Trust and Respect.

### UNIT - III ETHICS 5

Morals, Values and Ethics – Integrity – Work Ethics – Service Learning – Civic Virtue – Caring – Sharing – honesty – Courage – Empathy – Self Confidence – Ethical Human Conduct – Basic for humanistic Education, Constitution and universal order – Competence in professional ethics – Strategy for transition from the present state to Universal human order.

### Contact Periods

Lecture : 15 Periods      Tutorial : Nil      Practical : Nil      Total : 15 Periods

### Text Books :

- 1 Gaur.R.R.,Singal.R., Bangaria.G.P, “*Foundation Course in Human Values and Professional Ethics*”,Excel Book Private Ltd., New Delhi., 2009.

### Reference Books:

- 1 S.K. Chakraborty and Dabangshu Chakraborty, “*Human Values and Ethics:Achieving Holistic Exvellenace*”,ICFAI University Press, 2006
- 2 A.N Tripathy, “*Human Values*”,New Age International publishers,2003
- 3 M.Govindarajan, S.Natarajan and V.S. Senthil kumar, “*Engineering Ethics (including human values)*” Estern Economy Edition, Prentice Hall of India Ltd., 2004
- 4 E.G.Seebauer and Rober.L.Berry, “*Fundamentals of Ethics for Scientists and Engineers* ” Oxford University Press, 2000

## **COURSE OUTCOMES:**

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

- CO1:** Start exploring themselves, get comfortable to each other and to the teacher and start finding the need and relevance for the course.
- CO2:** See that their practice in living is not in harmony with their natural acceptance most of the time and able to refer to their natural acceptance to remove this disharmony.
- CO3:** Aware of their activities like understanding, desire, thought and selection and start finding their focus of attention at different moments.
- CO4:** Able to see that respect is right evaluation and only right evaluation leads to fulfilment in relationship.
- CO5:** Develop an understanding of the whole existence and interconnectedness in nature.

## **COURSE ARTICULATION MATRIX:**

CO /PO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	L	H	H	H	M	L	H	M	H	H	M	H	H	M
CO4	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
CO5	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
16NOC1Z1	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

**L- Low, M-Moderate (Medium), H-High**





Pre- Requisite : NIL

L	T	P	C
1	0	0	1

### COURSE OBJECTIVES

- Engineering ethics and human value
- Social responsibility of an Engineer
- Ethical dilemma while discharging duties in professional life.

### UNIT - I ENGINEERING ETHICS 5

Senses of Engineering Ethics – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – Kohlberg’s theory – Gilligen’s theory – Consensus and controversy – Models of Professional roles – theories about right actions – Self interest – customs and religion – uses of ethical theories - Valuing time – cooperation – commitment.

### UNIT - II ENGINEERING AS SOCIAL EXPERIMENTATION 5

Engineering as experimentation – engineers as responsible experimenters – codes of ethics – a balanced outlook on law – the challenger case study – engineers as managers – consulting engineers – Moral leadership.

### UNIT - III SAFETY, RESPONSIBILITIES, RIGHTS AND GLOBAL ISSUES 5

Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – the three mile island and Chernobyl case studies- Environmental ethics – computer ethics – weapons development – Multinational corporations – engineers as expert witnesses and advisors.

### CONTACT PERIODS

Lecture : 15 Periods      Tutorial : Nil      Practical : Nil      Total : 15 Periods

### TEXT BOOKS

- 1 Mike Martin and Roland Schinzinger, “*Ethics in Engineering*”, McGraw Hill, New York, 1996.
- 2 M. Govindaraman, S. Natarajan and V.S. Senthil kumar, “*Engineering Ethics (including human values)*”, Eastern Economy Edition, Prentice Hall of India Ltd., 2004.

### REFERENCE BOOKS

- 1 Charles D.Flenddermann, “*Engineering Ethics*” Pearson Education, 2004
- 2 Edmund G seebauer and Robert L. Berry, “*Fundamentals of Ethics for Scientists and Engineers*”,2001, Oxford University Press
- 3 Charles E. Harries, Michael S. Protchard and Michael J., “*Engineering Ethics-concepts and Cases*”, Thomson Learning, 2000.
- 4 John R. Boatright, “*Ethics and Conduct of Business*”, Pearson Education, 2003.

**COURSE OUTCOMES:**

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

**CO1:** Understand and appreciate human values, exhibit self confidence and develop good character.

**CO2:** Sense engineering ethics, professional roles and valuing time, co-operation and commitment.

**CO3:** Understand and practise code of ethics.

**CO4:** Assess safety and risk and capable of doing risk benefit analysis.

**CO5:** Develop and exhibit moral leadership qualities in exercising Engineering Consultations without compromising environmental, legal and ethical issues.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	L	H	H	H	M	L	H	M	H	H	M	H	H	M
CO4	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
CO5	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
16NOCX02	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

**L- Low, M-Moderate (Medium), H-High**



16NOCX03  
Pre- Requisite : NIL

**MATLAB PROGRAMMING**

**CATEGORY: OC**  
L T P C  
1 0 0 1

**COURSE OBJECTIVE**

- To familiarize with the main features of the MATLAB integrated design environment and its user interfaces.

**UNIT - I BASIC STRUCTURE AND FEATURES OF MATLAB 5**

Command window, figure window; editor window and help window- arithmetic operations with scalars, order of precedence- MATLAB as a calculator, display formats, math built-in functions, scalar variables, assignment operator; predefined variables - useful commands for managing variables - applications in problem solving.

**UNIT - II CREATING ARRAYS 5**

One dimensional and two dimensional array addressing; built-in functions for handling arrays, mathematical operations with matrices, strings and strings as variables; generation of random numbers; examples of MATLAB applications.

**UNIT - III SCRIPT FILES and PLOTS 5**

Creating and saving a script file, current directory; output commands. Plot command; line specifier's plot of a given data; plot of a function; plotting multiple graphs in the same plot.

**CONTACT PERIODS**

Lecture : 15 Periods      Tutorial : Nil      Practical : Nil      Total : 15 Periods

**Text Books :**

- Gilat Amos, *"MATLAB: An Introduction with Applications"*, John Wiley & Sons, Inc (Wiley Student Edition), 2008.

**Reference Books:**

- Herniter, E. Marc, *"Programming in MATLAB"*, Brooks/Cole, Thomson Learning.

**COURSE OUTCOMES:**

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

- CO1:** Familiarize the student in introducing and exploring MATLAB software.
- CO2:** Enable how to approach for solving Engineering problems using simulation tools.
- CO3:** Prepare to use MATLAB in their project works.
- CO4:** Provide a foundation in use of this software for real time applications.

**Course Articulation Matrix**

CO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	L	H	H	H	M	L	H	M	H	H	M	H	H	M
CO4	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
16NOCX03	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

L- Low, M – Moderate (Medium), H - High

**16NOCX04****CALIBRATION OF INSTRUMENTS****CATEGORY : OC**

L T P C

0 0 1 1

**Pre- Requisite : NIL****COURSE OBJECTIVES**

- To discuss various instrument calibration, maintenance issues and be provided with the most up-to-date information and best practice in dealing with field instruments for all industrial application.

**LIST OF EXPERIMENTS**

- Calibration of Voltmeter
- Calibration of Ammeter
- Calibration of Wattmeter
- Calibration of Energy meter
- Universal calibrator
- Calibration of pH meter
- Calibration of Pressure gauge
- Basic Instrument - Troubleshooting and Repair.

**CONTACT PERIODS**

Lecture : Nil

Tutorial : Nil

Practical : 15 Periods

Total : 15 Periods

**COURSE OUTCOMES:**

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

- CO1:** Have a better understanding of the technology and methods associated with verification and calibration.
- CO2:** Select proper measuring instrument and know requirement of calibration, errors in measurement etc.
- CO3:** Expand their skills through on-the-job training, as well as practical experience gained on the plant.

**COURSE ARTICULATION MATRIX:**

CO/ PO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	L	H	H	H	M	L	H	M	H	H	M	H	H	M
16NOCX04	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

**L- Low, M-Moderate (Medium), H-High**

16NOCX05

LabVIEW PROGRAMMING

CATEGORY : OC

L	T	P	C
0	0	1	1

Pre- Requisite : NIL

COURSE OBJECTIVES

- To familiarize the student in introducing and exploring LABVIEW software.
- To enable the student on how to approach for solving Engineering problems using simulation tools.
- To prepare the students to use LABVIEW in their project works.

LIST OF EXPERIMENTS

- Simple exercise with VI (creating, editing, developing).
- Converting the VI into a Sub VI.
- Create simple functions (FOR loop, While loop) using VI.
- Lab VIEW Programming (Case Structure, Arrays, Clusters)
- Waveform measurements
- Voltage to frequency converter
- Oscilloscope - Attribute Nodes

CONTACT PERIODS

Lecture : Nil      Tutorial : Nil      Practical : 15 Periods      Total : 15 Periods

Text Books:

- 1 Sanjay Gupta and Joseph John,“*Virtual Instrumentation using LabVIEW*”  
Tata McGraw-Hill, Second edition 2010

Reference Books:

- 1 Lisa K Wells and Jeffrey Travels,“*Labview for everyone*”,Prentice Hall, 3<sup>rd</sup> Edition 2009.
- 2 Jovitha Jerome,“*Virtual Instrumentation Using LabVIEW*” ,PHI Learning Pvt. Ltd 1<sup>st</sup> Edition, 2010

COURSE OUTCOMES:

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

- CO1:** Familiarize the student in introducing and exploring LABVIEW software.
- CO2:** Enable how to approach for solving Engineering problems using simulation tools.
- CO3:** Prepare to use LABVIEW in their project works.
- CO4:** Provide a foundation in use of this software for real time applications.

COURSE ARTICULATION MARTIX:

CO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	L	H	H	H	M	L	H	M	H	H	M	H	H	M
CO4	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
16NOCX05	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

L- Low, M-Moderate (Medium), H-High

16NOCX06

GRAPHICAL SYSTEM DESIGN

CATEGORY : OC

L	T	P	C
0	0	1	1

Pre- Requisite : NIL

**COURSE OBJECTIVES**

- To provide a foundation in use of this softwares for real time applications.

**LIST OF EXPERIMENTS**

- Acquisition of Strain and Temperature with NI Elvis
- Signal Generation Using NI-DAQmx
- RC Circuit measurement LPF and HPF
- Digital control of stepper motor
- OPAMP circuits
- ADC and DAC converter
- System identification and analysis of Electrical Circuits

**CONTACT PERIODS**

Lecture : Nil                      Tutorial : Nil                      Practical : 15 Periods                      Total : 15 Periods

**Text Books :**

- Gary Johnson, Richard Jennings, "*Lab view graphical programming*", Tata McGraw Hill, 2011.

**Reference Books:**

- S. Gupta, J.P. Gupta, "*PC interfacing for data acquisition and process control*" 2<sup>nd</sup> Ed., Instrument Society of America, 1994
- Jovitha Jerome, "*Virtual Instrumentation Using LabVIEW*", PHI Learning Pvt. Ltd 1<sup>st</sup> Edition, 2010

**COURSE OUTCOMES:**

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

- CO1:** Familiarize the student in introducing and exploring LABVIEW software.
- CO2:** Enable how to approach for solving Engineering problems using simulation tools.
- CO3:** Prepare to use LABVIEW in their project works.
- CO4:** Provide a foundation in use of this software for real time applications.

**COURSE ARTICULATION MARTIX:**

CO /PO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	L	H	H	H	M	L	H	M	H	H	M	H	H	M
CO4	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
16NOCX06	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

L- Low, M-Moderate (Medium), H-High

16NOCX07

**PCB DESIGN AND FABRICATION**

(common with EEE)

**CATEGORY : OC**

L T P C

0 0 1 1

**Pre- Requisite : Nil**

**COURSE OBJECTIVES**

- To acquire knowledge on assembling and testing of PCB based electronics circuits and become familiar with the simulation software.

**LIST OF EXPERIMENTS**

- Introduction to PCB Designing
- Scope of PCB Designing
- Hardware on Breadboard
- Software Description
- Design circuit on PCB software (Proteus, Express PCB, ARES)
- Schematic Layout
- Board creation
- Fabrication Process
- Design of single sided PCB

**CONTACT PERIODS**

Lecture : Nil

Tutorial : Nil

Practical : 15 Periods

Total : 15 Periods

**Text Books :**

- Clyde Coombs, *“Printed Circuits Handbook”*, TMH, 2007.

**Reference Books:**

- Kraig Mitzner, *“Complete PCB Design Using OrCAD Capture and PCB Editor”* Newnes; Pap/Cdr edition, 28 May 2009.
- Simon Monk, *“Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards”*, TMH, 2014.

**COURSE OUTCOMES:**

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

**CO1:** Familiarize PCB Circuit Terminology.

**CO2:** Design a circuit and create a schematic Capture.

**CO3:** Become proficient with computer for drawing Schematic and PCB Layout.

**CO4:** To Create New part and to Fabricate a Prototype PCB.

**COURSE ARTICULATION MARTIX:**

CO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	L	H	H	H	M	L	H	M	H	H	M	H	H	M
CO4	L	M	H	H	H	M	L	H	M	M	M	H	H	M	H
16NOCX07	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

**L- Low, M-Moderate (Medium), H-High**

16NOCX08

**ELECTRICAL WIRING, WINDING AND  
EARTHING REPAIRING OF HOUSEHOLD**

**CATEGORY : OC**

**APPLIANCES**

(common to EEE)

L T P C  
0 0 1 1

1. Conductors, Insulators & its types
2. Crimping & Crimping Tools, Soldering
3. Joints in Electrical Conductor
4. Concept of gauge of wire, conductor
5. Determination of Fuse size according to the load of circuit and its location
6. Study of different components used in house wiring.
7. Concept of earthing, purpose & types
8. Pipe earthing & Plate earthing
9. Earthing of domestic installation
10. Use of Megger & Test lamps in fault location

**CONTACT PERIODS**

Lecture : Nil

Tutorial : Nil

Practical : 15 Periods

Total : 15 Periods

**COURSE OUTCOMES:**

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

**CO1 :** Acquire knowledge about various types of wiring systems, wiring tools, lighting & wiring accessories, wiring estimation & costing, etc.

**CO2 :** Acquire knowledge about household electrical appliances, need of earthing, electric shock, etc.

**COURSE ARTICULATION MATRIX:**

CO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
16NOCX08	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

**L- Low, M-Moderate (Medium), H-High**



**16NOCX09 NON DESTRUCTIVE TESTING TECHNIQUES CATEGORY : OC**

**Pre- Requisite : Nil**

L	T	P	C
1	0	0	1

**COURSE OBJECTIVES**

- To give a general overview of novel non destructive testing methods, the principles behind them, their uses, the advantages and limitations, both in application and defect detection capability.

**UNIT - I NON-DESTRUCTIVE TESTING 5**

Non-destructive testing (NDT): role, components and advantages; common NDT techniques.

**UNIT - II ULTRASONIC TESTING 5**

Ultrasonic flaw detection: principle, working and applications, advantages and limitations.

**UNIT - III EDDY CURRENT TESTING & MAGNETIC TESTING 5**

Principle, working and applications of eddy current testing; probes and sensors; testing procedures, applications, advantages and imitations.

Magnetic testing: particle, flux leakage testing; magnetization methods. applications and imitations

**CONTACT PERIODS**

Lecture : 15 Periods      Tutorial : Nil      Practical : Nil      Total : 15 Periods

**Text Books :**

- Baldev Raj, Jayakumar T., and Thavasimuthu M., "*Practical Non-Destructive Testing*" Narosa Publishing, 1997.

**Reference Books:**

- Halmshaw R , "*Non-Destructive Testing*" Edward Arnold, 1989.
- Hull, "*Non-Destructive Testing*" ELBS Edition, 1991.

**COURSE OUTCOMES:**

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

- CO1:** Have a better knowledge in the field of advanced techniques in ultrasonic NDE.
- CO2:** Understand the recent developments in NDE and their application in various industries
- CO3:** Differentiate various defect types and select the appropriate NDT methods for better Evaluation

**COURSE ARTICULATION MARTIX:**

CO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
16NOCX09	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

**L- Low, M-Moderate (Medium), H-High**

**16NOCX10****ELECTRICAL SAFETY**  
(Common to EEE)**CATEGORY : OC**

L	T	P	C
1	0	0	1

**Pre- Requisite : Nil****COURSE OBJECTIVES**

- To gain skills in identifying the presence of electrical hazards, implementing measures to minimise risks and develop skills in investigative techniques for determining the cause of electrical accidents, fires and explosions.

**UNIT - I ELECTRICAL HAZARDS****8**

Primary and secondary hazards - Human safety in the use of electricity. Energy leakage - Clearances and insulation - Current surges- - Heating effects of current - Electromagnetic forces -Corona effect - Static electricity – Definition, sources, hazardous conditions, electrical causes of fire and explosion - Ionization, spark and arc ignition energy - National electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – Earthing, specifications, earth resistance, earth pit maintenance - Indian electricity act and rules - Statutory requirements from electrical inspectorate

**UNIT - II PROTECTION SYSTEMS****7**

Fuse, circuit breakers and overload relays – Protection against over voltage and under voltage – Safe limits of amperage – Voltage – Safe distance from lines - Protection against Electric Shock - Protection against Direct Contact - Protection against Thermal Effects – Grounding - Emergency Switching - Protective devices - Safety in handling hand held electrical appliances tools

**CONTACT PERIODS**

Lecture : 15 Periods

Tutorial : Nil

Practical : Nil

Total : 15 Periods

**Text Books :**

- W. Fordham Cooper, “**Electrical Safety Engineering**”, second edition, Butterworth & Co.,1986
- D.C. Winburn,“**Practical Electrical Safety**”,Marcel Dekker Inc., 1988

**Reference Books:**

- John Cadick, Mary Capelli-Schellpfeffer, Dennis Neitzel, “*Electrical Safety Handbook*” 3rd edition, McGraw-Hill, 2006.
- J. Maxwell Adams, “*ELECTRICAL SAFETY - A guide to the causes and prevention of electrical hazards*”, The Institution of Electrical Engineers, 1994.
- Indian Electricity Act and Rules, Government of India.*

**COURSE OUTCOMES:**

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

**CO1:** Understand the Indian electricity rules and their significance**CO2:** Explain the safety standard in residential, commercial, and agricultural**CO3:** Learn about electrical safety installation, testing and commission**COURSE ARTICULATION MARTIX:**

CO	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	M	M	H	H	L	L	M	H	H	L	H	M	H	M	H
CO2	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
CO3	M	M	H	H	H	M	L	H	H	M	M	H	H	H	H
16NOCX10	M	M	H	H	M	M	L	H	M	M	H	M	H	M	H

**L- Low, M-Moderate (Medium), H-High**