ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

Educational Objectives

Bachelor of Electronics and Instrumentation Engineering curriculum is designed to prepare the graduates having attitude and knowledge to

1. Have successful technical and professional careers in their chosen fields such as Process Control, Electronics & Information Technology.
2. Engross in life long process of learning to keep themselves abreast of new developments in the field of Electronics & Instrumentation

Programme Outcomes

The graduates will have the ability to

a. Apply the Mathematical knowledge and the basics of Science and Engineering to solve the problems pertaining to Electronics and Instrumentation Engineering.
b. Identify and formulate Instrumentation Engineering problems from research literature and be able to analyze the problem using first principles of Mathematics and Engineering Sciences.
c. Come out with solutions for the complex problems and to design system components or process that fulfill the particular needs taking into account public health and safety and the social, cultural and environmental issues.
d. Draw well-founded conclusions applying the knowledge acquired from research and research methods including design of experiments, analysis and interpretation of data and synthesis of information and to arrive at significant conclusion.
e. Form, select and apply relevant techniques, resources and Engineering and IT tools for Engineering activities like electronic prototyping, modeling and control of systems/processes and also being conscious of the limitations.
f. Understand the role and responsibility of the Professional Instrumentation Engineer and to assess societal, health, safety issues based on the reasoning received from the contextual knowledge.
g. Be aware of the impact of professional Engineering solutions in societal and environmental contexts and exhibit the knowledge and the need for sustainable Development.
h. Apply the principles of Professional Ethics to adhere to the norms of the engineering practice and to discharge ethical responsibilities.
i. Function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.
j. Communicate efficiently the engineering facts with a wide range of engineering community and others, to understand and prepare reports and design documents; to make effective presentations and to frame and follow instructions.
k. Demonstrate the acquisition of the body of engineering knowledge and insight and Management Principles and to apply them as member / leader in teams and multidisciplinary environments.
l. Recognize the need for self and life-long learning, keeping pace with technological challenges in the broadest sense.

PEO \ PO	a	b	c	d	e	f	g	h	i	j	k	l
1	✓	✓	✓	✓	✓			✓	✓	✓	✓	
2	✓	✓	✓	✓	✓	✓	✓				✓	✓

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
	THEORY												
SEM I	Communicative English									✓	✓		✓
	Engineering Mathematics- I	✓	✓			✓							✓
	Engineering Physics	✓	✓	✓		✓		✓					✓
	Engineering Chemistry	✓	✓	✓		✓							✓
	Problem Solving and Python Programming	✓	✓	✓	✓	✓							✓
	Engineering Graphics			✓	✓								
	PRACTICAL												
	Problem Solving and Python Programming Laboratory	✓		✓	✓	✓	✓				✓		✓
	Physics and Chemistry Laboratory	✓	✓										
	THEORY												
SEM II	Technical English									✓	✓		✓
	Engineering Mathematics- II	✓	✓	✓		✓							✓
	Physics For Electronics Engineering	✓	✓	✓		✓		✓					✓
	Basic Civil and Mechanical Engineering				✓		✓						
	Circuit Theory	✓	✓	✓	✓	✓							✓
	Environmental Science and Engineering	✓	✓			✓	✓	✓	✓				✓
	PRACTICALS												
	Engineering Practices Laboratory	✓		✓	✓	✓	✓				✓		
	Electric Circuits Laboratory	✓		✓	✓	✓	✓				✓		✓
	THEORY												
SEM III	Transforms and Partial Differential Equations	✓	✓			✓							✓
	Electron Devices and Circuits	✓	✓	✓	✓	✓							✓
	Digital Logic Circuits				✓	✓							
	Electrical Measurements	✓			✓	✓							✓
	Transducers Engineering	✓	✓	✓	✓	✓							✓
	Object Oriented Programming			✓	✓	✓							✓

	PRACTICALS												
	Measurements and Transducers Laboratory					✓	✓						✓
	Object Oriented Programming Laboratory			✓	✓	✓							✓
	THEORY	a	b	c	d	e	f	g	h	i	j	k	l
SEM IV	Numerical Methods	✓	✓	✓									✓
	Electrical Machines		✓	✓			✓			✓			✓
	Industrial Instrumentation - I			✓	✓	✓	✓	✓					
	Linear integrated Circuits and Applications	✓	✓	✓		✓							
	Control Systems	✓	✓	✓	✓								
	Communication Engineering	✓		✓				✓					
	PRACTICALS												
	Devices and Machines Laboratory	✓			✓	✓						✓	✓
	Linear and Digital integrated Circuits Laboratory	✓		✓	✓						✓	✓	✓
	THEORY												
SEM V	Analytical Instruments				✓	✓	✓						
	Industrial Instrumentation - II			✓	✓	✓	✓	✓					
	Process Control	✓	✓	✓	✓	✓	✓						
	Microprocessors and Microcontrollers					✓		✓		✓			✓
	Digital Signal Processing	✓	✓	✓		✓							
	Open Elective I												
	PRACTICALS												
	Industrial Instrumentation Laboratory			✓	✓	✓	✓			✓	✓		
	Microprocessors and Microcontrollers Laboratory		✓	✓	✓					✓	✓		
	THEORY												
SEM VI	Logic and Distributed Control System	✓		✓		✓							
	Computer Control of Processes	✓	✓		✓								
	Data Structures												

	Electronic Instrumentation			✓	✓	✓							
	Professional Elective I												
	Professional Elective II												
	PRACTICALS	a	b	c	d	e	f	g	h	i	j	k	l
	Data Structures Laboratory			✓	✓	✓	✓				✓		✓
	Process Control Laboratory		✓	✓	✓	✓	✓			✓	✓		
	Professional Communication									✓	✓	✓	
	THEORY												
SEM VII	Industrial Data Networks				✓	✓							
	Embedded Systems			✓	✓	✓					✓		✓
	Digital Image Processing												
	Professional Elective III												
	Professional Elective IV												
	Open Elective - II												
	PRACTICALS												
	Industrial Automation Laboratory		✓		✓	✓	✓			✓			
	Instrumentation System Design Laboratory			✓	✓	✓					✓		
	THEORY												
SEM VIII	Professional Elective V			✓	✓	✓	✓						✓
	Professional Elective VI												
	PRACTICALS												
	Project Work	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

. **PROFESSIONAL ELECTIVE**

SL.NO.	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
	THEORY												
ELECTIVE – I	MEMS and Nano Science		✓	✓					✓	✓			
	Power Electronics and Drives	✓	✓		✓	✓							
	System Identification	✓		✓	✓	✓		✓					
	Computer Networks				✓	✓							
	Intellectual Property Rights								✓		✓		✓
ELECTIVE – II	Advanced Instrumentation Systems	✓		✓		✓							
	Adaptive Control	✓		✓	✓	✓			✓				
	Applied Soft Computing	✓	✓			✓						✓	✓
ELECTIVE – III	Fibre Optics and Laser Instrumentation	✓		✓									
	Electromagnetic Theory	✓	✓	✓		✓							
	Disaster Management		✓		✓		✓	✓					✓
	Human Rights												
	Operations Research	✓	✓	✓					✓	✓			✓
ELECTIVE – IV	Thermal Power Plant Instrumentation	✓	✓	✓		✓							
	Advanced Digital Signal Processing	✓		✓		✓							
	Optimal Control	✓		✓		✓			✓				
	Radar and Navigational Aids	✓	✓	✓			✓	✓					
	Total Quality Management		✓			✓	✓	✓	✓	✓	✓		
	VLSI Design	✓		✓		✓							
ELECTIVE – V	Biomedical Instrumentation			✓	✓	✓	✓						✓
	Instrumentation in Petrochemical Industries	✓		✓		✓							

	Professional Ethics in Engineering	✓	✓		✓			✓				✓	✓
	Principles of Management					✓	✓			✓			
ELECTIVE – VI	Project Management and Finance						✓			✓			
	Advanced Process Control	✓	✓	✓	✓	✓	✓						
	Unit Operation and Control	✓		✓		✓					✓		✓
	Robotics and Automation	✓	✓	✓		✓							
	Fundamentals of Nano Science												

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CHOICE BASED CREDIT SYSTEM
I TO VIII SEMESTERS CURRICULA & SYLLABI

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	MA8151	Engineering Mathematics - I	BS	4	4	0	0	4
3.	PH8151	Engineering Physics	BS	3	3	0	0	3
4.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE8151	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	GE8152	Engineering Graphics	ES	6	2	0	4	4
PRACTICALS								
7.	GE8161	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	BS8161	Physics and Chemistry Laboratory	BS	4	0	0	4	2
			TOTAL	**31**	**19**	**0**	**12**	**25**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS8251	Technical English	HS	4	4	0	0	4
2.	MA8251	Engineering Mathematics - II	BS	4	4	0	0	4
3.	PH8253	Physics for Electronics Engineering	BS	3	3	0	0	3
4.	BE8252	Basic Civil and Mechanical Engineering	ES	4	4	0	0	4
5.	EE8251	Circuit Theory	PC	4	2	2	0	3
6.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3
PRACTICALS								
7.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	EE8261	Electric Circuits Laboratory	PC	4	0	0	4	2
			TOTAL	**30**	**20**	**2**	**8**	**25**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
2.	EC8353	Electron Devices and Circuits	ES	3	3	0	0	3
3.	EE8351	Digital Logic Circuits	PC	4	2	2	0	3
4.	EI8351	Electrical Measurements	PC	4	2	2	0	3
5.	EI8352	Transducers Engineering	PC	3	3	0	0	3
6.	CS8392	Object Oriented Programming	ES	3	3	0	0	3
PRACTICALS								
7.	EI8361	Measurements and Transducers Laboratory	PC	4	0	0	4	2
8.	CS8383	Object Oriented Programming Laboratory	ES	4	0	0	4	2
			TOTAL	**29**	**17**	**4**	**8**	**23**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA8491	Numerical Methods	BS	4	4	0	0	4
2.	EI8451	Electrical Machines	ES	3	3	0	0	3
3.	EI8452	Industrial Instrumentation - I	PC	3	3	0	0	3
4.	EE8451	Linear Integrated Circuits and Applications	PC	3	3	0	0	3
5.	IC8451	Control Systems	PC	5	3	2	0	4
6.	EC8395	Communication Engineering	ES	3	3	0	0	3
PRACTICALS								
7.	EI8461	Devices and Machines Laboratory	PC	4	0	0	4	2
8.	EE8461	Linear and Digital Integrated Circuits Laboratory	PC	4	0	0	4	2
			TOTAL	**29**	**19**	**2**	**8**	**24**

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI8551	Analytical Instruments	PC	3	3	0	0	3
2.	EI8552	Industrial Instrumentation - II	PC	3	3	0	0	3
3.	EI8553	Process Control	PC	4	2	2	0	3
4.	EE8551	Microprocessors and Microcontrollers	PC	3	3	0	0	3
5.	EE8591	Digital Signal Processing	PC	4	2	2	0	3
6.		Open Elective I*	OE	3	3	0	0	3
PRACTICALS								
7.	EI8561	Industrial Instrumentation Laboratory	PC	4	0	0	4	2
8.	EE8681	Microprocessors and Microcontrollers Laboratory	PC	4	0	0	4	2
			TOTAL	**28**	**16**	**4**	**8**	**22**

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI8651	Logic and Distributed Control System	PC	3	3	0	0	3
2.	EI8691	Computer Control of Processes	PC	3	3	0	0	3
3.	CS8391	Data Structures	ES	3	3	0	0	3
4.	EI8692	Electronic Instrumentation	PC	3	3	0	0	3
5.		Professional Elective I	PE	3	3	0	0	3
6.		Professional Elective II	PE	3	3	0	0	3
PRACTICALS								
7.	CS8381	Data Structures Laboratory	ES	4	0	0	4	2
8.	EI8661	Process Control Laboratory	PC	4	0	0	4	2
9.	HS8581	Professional Communication	EEC	2	0	0	2	1
			TOTAL	**28**	**18**	**0**	**10**	**23**

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI8751	Industrial Data Networks	PC	3	3	0	0	3
2.	EE8691	Embedded Systems	PC	3	3	0	0	3
3.	EC8093	Digital Image Processing	PC	3	3	0	0	3
4.		Professional Elective III	PE	3	3	0	0	3
5.		Professional Elective IV	PE	3	3	0	0	3
6.		Open Elective II*	OE	3	3	0	0	3
PRACTICALS								
7.	EI8761	Industrial Automation Laboratory	PC	4	0	0	4	2
8.	EI8762	Instrumentation System Design Laboratory	PC	4	0	0	4	2
			TOTAL	**26**	**18**	**0**	**8**	**22**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective V	PE	3	3	0	0	3
2.		Professional Elective VI	PE	3	3	0	0	3
PRACTICALS								
3.	EI8811	Project Work	EEC	20	0	0	20	10
			TOTAL	**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS:180

*Course from the curriculum of other UG Programmes.

PROFESSIONAL ELECTIVE – I (VI SEMESTER)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE8072	MEMS and Nano Science	PE	3	3	0	0	3
2.	EI8077	Power Electronics and Drives	PE	3	3	0	0	3
3.	IC8072	System Identification	PE	4	2	2	0	3
4.	EI8074	Computer Networks	PE	4	2	2	0	3
5.	GE8075	Intellectual Property Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – II (VI SEMESTER)

1.	EI8071	Adaptive Control	PE	4	2	2	0	3
2.	EI8072	Advanced Instrumentation Systems	PE	3	3	0	0	3
3.	EE8071	Applied Soft Computing	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – III (VII SEMESTER)

1.	EI8075	Fibre Optics and Laser Instrumentation	PE	3	3	0	0	3
2.	EE8391	Electromagnetic Theory	PE	4	2	2	0	3
3.	GE8071	Disaster Management	PE	3	3	0	0	3
4.	GE8074	Human Rights	PE	3	3	0	0	3
5.	MG8491	Operations Research	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

1.	EI8092	Thermal Power Plant Instrumentation	PE	3	3	0	0	3
2.	EC8091	Advanced Digital Signal Processing	PE	3	3	0	0	3
3.	EI8076	Optimal Control	PE	4	2	2	0	3
4.	TL8071	Radar and Navigational Aids	PE	3	3	0	0	3
5.	GE8077	Total Quality Management	PE	3	3	0	0	3
6.	EC8095	VLSI Design	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

1.	EI8073	Biomedical Instrumentation	PE	3	3	0	0	3
2.	EI8091	Instrumentation in Petrochemical Industries	PE	3	3	0	0	3
3.	GE8076	Professional Ethics in Engineering	PE	3	3	0	0	3
4.	MG8591	Principles of Management	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – VI (VIII SEMESTER)

1.	EI8078	Project Management and Finance	PE	3	3	0	0	3
2.	IC8071	Advanced Process Control	PE	4	2	2	0	3
3.	EI8093	Unit Operation and Control	PE	3	3	0	0	3
4.	EI8079	Robotics and Automation	PE	3	3	0	0	3
5.	GE8073	Fundamentals of Nano Science	PE	3	3	0	0	3

***Professional Electives are grouped according to elective number as was done previously.**

HUMANITIES AND SOCIALSCIENCES (HS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS8151	Communicative English	HS	4	4	0	0	4
2.	HS8251	Technical English	HS	4	4	0	0	4
3.	GE8291	Environmental Science and Engineering	HS	3	3	0	0	3

BASIC SCIENCES (BS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA8151	Engineering Mathematics I	BS	4	4	0	0	4
2.	PH8151	Engineering Physics	BS	3	3	0	0	3
3.	CY8151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS8161	Physics and Chemistry	BS	4	0	0	4	2

		Laboratory						
5.	MA8251	Engineering Mathematics II	BS	4	4	0	0	4
6.	PH8253	Physics for Electronics Engineering	BS	3	3	0	0	3
7.	MA8353	Transforms and Partial Differential Equations	BS	4	4	0	0	4
8.	MA8491	Numerical Methods	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE8151	Problem Solving and Python programming	ES	3	3	0	0	3
2.	GE8152	Engineering Graphics	ES	6	2	0	4	4
3.	GE8161	Problem Solving and Python programming Laboratory	ES	4	0	0	4	2
4.	BE8252	Basic Civil and Mechanical Engineering	ES	4	4	0	0	4
5.	GE8261	Engineering Practices Laboratory	ES	4	0	0	4	2
6.	EC8353	Electron Devices and Circuits	ES	3	3	0	0	3
7.	CS8392	Object Oriented Programming	ES	3	3	0	0	3
8.	CS8383	Object Oriented Programming Laboratory	ES	4	0	0	4	2
9.	EI8451	Electrical Machines	ES	3	3	0	0	3
10.	EC8395	Communication Engineering	ES	3	3	0	0	3
11.	CS8391	Data Structures	ES	3	3	0	0	3
12.	CS8381	Data Structures Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EE8251	Circuit Theory	PC	4	2	2	0	3
2.	EE8261	Electric Circuits Laboratory	PC	4	0	0	4	2
3.	EE8351	Digital Logic Circuits	PC	4	2	2	0	3
4.	EI8351	Electrical Measurements	PC	4	2	2	0	3
5.	EI8352	Transducers Engineering	PC	3	3	0	0	3
6.	EI8361	Measurements and Transducers Laboratory	PC	4	0	0	4	2
7.	EI8452	Industrial Instrumentation - I	PC	3	3	0	0	3
8.	EE8451	Linear integrated Circuits and Applications	PC	3	3	0	0	3
9.	IC8451	Control Systems	PC	5	3	2	0	4
10.	EI8461	Devices and Machines Laboratory	PC	4	0	0	4	2
11.	EE8461	Linear and Digital integrated Circuits Laboratory	PC	4	0	0	4	2
12.	EI8551	Analytical Instruments	PC	3	3	0	0	3
13.	EI8552	Industrial Instrumentation - II	PC	3	3	0	0	3
14.	EI8553	Process Control	PC	4	2	2	0	3
15.	EE8551	Microprocessors and Microcontrollers	PC	3	3	0	0	3
16.	EE8591	Digital Signal Processing	PC	4	2	2	0	3
17.	EI8561	Industrial Instrumentation Laboratory	PC	4	0	0	4	2
18.	EE8681	Microprocessors and Microcontrollers Laboratory	PC	4	0	0	4	2
19.	EI8651	Logic and Distributed Control System	PC	3	3	0	0	3
20.	EI8691	Computer Control of Processes	PC	3	3	0	0	3

21.	EI8692	Electronic Instrumentation	PC	3	3	0	0	3
22.	EI8661	Process Control Laboratory	PC	4	0	0	4	2
23.	EI8751	Industrial Data Networks	PC	3	3	0	0	3
24.	EE8691	Embedded Systems	PC	3	3	0	0	3
25.	EC8093	Digital Image Processing	PC	3	3	0	0	3
26.	EI8761	Industrial Automation Laboratory	PC	4	0	0	4	2
27.	EI8762	Instrumentation System Design Laboratory	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS8581	Professional Communication	EEC	2	0	0	2	1
2.	EI8811	Project work	EEC	20	0	0	20	10

SUMMARY

S.NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	4	7	-	-		-	-		11
2.	BS	12	7	4	4		-	-		27
3.	ES	9	6	8	6		5	-		34
4.	PC	-	5	11	14	19	11	13		73
5.	PE						6	6	6	18
6.	OE					3		3	-	6
7.	EEC						1		10	11
	Total	25	25	23	24	22	23	22	16	180
	Non Credit / Mandatory	-	-	-	-	-	-	-	-	0

HS8151 **COMMUNICATIVE ENGLISH**

L	T	P	C
4	0	0	4

OBJECTIVES:

- To develop the basic reading and writing skills of first year engineering and technology students.
- To help learners develop their listening skills, which will, enable them listen to lectures and comprehend them by asking questions; seeking clarifications.
- To help learners develop their speaking skills and speak fluently in real contexts.
- To help learners develop vocabulary of a general kind by developing their reading skills

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY& FRIENDS 12

Reading- short comprehension passages, practice in skimming-scanning and predicting- **Writing**- completing sentences- - developing hints. **Listening**- short texts- short formal and informal conversations. **Speaking-** introducing oneself - exchanging personal information- **Language development**- Wh- Questions- asking and answering-yes or no questions- parts of speech. **Vocabulary development-**- prefixes- suffixes- articles.- count/ uncount nouns.

UNIT II GENERAL READING AND FREE WRITING 12

Reading - comprehension-pre-reading-post reading- comprehension questions (multiple choice questions and /or short questions/ open-ended questions)-inductive reading- short narratives and descriptions from newspapers including dialogues and conversations (also used as short Listening texts)- register- **Writing** – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –**Listening**- telephonic conversations. **Speaking –** sharing information of a personal kind—greeting – taking leave- **Language development** – prepositions, conjunctions **Vocabulary development-** guessing meanings of words in context.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 12

Reading- short texts and longer passages (close reading) **Writing-** understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences **Listening** – listening to longer texts and filling up the table- product description- narratives from different sources. **Speaking**- asking about routine actions and expressing opinions. **Language development**- degrees of comparison- pronouns- direct vs indirect questions- **Vocabulary development –** single word substitutes- adverbs.

UNIT IV READING AND LANGUAGE DEVELOPMENT 12

Reading- comprehension-reading longer texts- reading different types of texts- magazines **Writing**- letter writing, informal or personal letters-e-mails-conventions of personal email- **Listening**- listening to dialogues or conversations and completing exercises based on them. **Speaking-** speaking about oneself- speaking about one's friend- **Language development-** Tenses- simple present-simple past-present continuous and past continuous- **Vocabulary development**- synonyms-antonyms- phrasal verbs

UNIT V EXTENDED WRITING **12**

Reading- longer texts- close reading –**Writing**- brainstorming -writing short essays **–** developing an outline- identifying main and subordinate ideas- dialogue writing-**Listening** – listening to talks-conversations- **Speaking –** participating in conversations- short group conversations-**Language development**-modal verbs- present/ past perfect tense - **Vocabulary development**-collocations-fixed and semi-fixed expressions

TOTAL: 60 PERIODS

OUTCOMES: At the end of the course, learners will be able to:

- Read articles of a general kind in magazines and newspapers.
- Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.
- Comprehend conversations and short talks delivered in English
- Write short essays of a general kind and personal letters and emails in English.

TEXT BOOKS:

1. Board of Editors. **Using English** A Coursebook for Undergarduate Engineers and Technologists**.** Orient BlackSwan Limited, Hyderabad: 2015
2. Richards, C. Jack. **Interchange Students' Book-2** New Delhi: CUP, 2015.

REFERENCES

1 Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.

2 Comfort, Jeremy, et al. **Speaking Effectively : Developing Speaking Skillsfor BusinessEnglish.** Cambridge University Press, Cambridge: Reprint 2011

3 Dutt P. Kiranmai and RajeevanGeeta. **Basic Communication Skills,** Foundation Books: 2013

4 Means,L. Thomas and Elaine Langlois. **English & Communication For Colleges.** CengageLearning ,USA: 2007

5 Redston, Chris &Gillies Cunningham **Face2Face** (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005

MA8151 ENGINEERING MATHEMATICS – I LT P C
4 0 0 4

OBJECTIVES :

- The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

UNIT I DIFFERENTIAL CALCULUS 12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT III INTEGRAL CALCULUS 12

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

UNIT IV MULTIPLE INTEGRALS 12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

UNIT V DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients - Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

TOTAL : 60 PERIODS

OUTCOMES :

After completing this course, students should demonstrate competency in the following skills:

- Use both the limit definition and rules of differentiation to differentiate functions.
- Apply differentiation to solve maxima and minima problems.
- Evaluate integrals both by using Riemann sums and by using the Fundamental Theorem of Calculus.
- Apply integration to compute multiple integrals, area, volume, integrals in polar coordinates, in addition to change of order and change of variables.
- Evaluate integrals using techniques of integration, such as substitution, partial fractions and integration by parts.
- Determine convergence/divergence of improper integrals and evaluate convergent improper integrals.
- Apply various techniques in solving differential equations.

TEXT BOOKS :

1. Grewal B.S., “Higher Engineering Mathematics”, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7(Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1(Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES :

1. Anton, H, Bivens, I and Davis, S, "Calculus", Wiley, 10th Edition, 2016.
2. Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Narayanan, S. and Manicavachagom Pillai, T. K., “Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
4. Srimantha Pal and Bhunia, S.C, "Engineering Mathematics" Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, "Thomas Calculus", 12th Edition, Pearson India, 2016.

PH8151 ENGINEERING PHYSICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I PROPERTIES OF MATTER **9**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT II WAVES AND FIBER OPTICS **9**

Oscillatory motion – forced and damped oscillations: differential equation and its solution – plane progressive waves – wave equation. Lasers : population of energy levels, Einstein’s A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers - fibre optic sensors: pressure and displacement.

UNIT III THERMAL PHYSICS **9**

Transfer of heat energy – thermal expansion of solids and liquids – expansion joints - bimetallic strips - thermal conduction, convection and radiation – heat conductions in solids – thermal conductivity - Forbe’s and Lee’s disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT IV QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Compton effect: theory and experimental verification – wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box – tunnelling (qualitative) - scanning tunnelling microscope.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, Miller indices – inter-planar distances - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - crystal imperfections: point defects, line defects – Burger vectors, stacking faults – role of imperfections in plastic deformation - growth of single crystals: solution and melt growth techniques.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course,

- the students will gain knowledge on the basics of properties of matter and its applications,
- the students will acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2012.

REFERENCES:

1. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. "Physics for Scientists and Engineers". Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.

CY8151 **ENGINEERING CHEMISTRY** **L T P C**
3 0 0 3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.

UNIT I WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA – numerical problems – boiler troubles (scale and sludge) – treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) external treatment – Ion exchange process, zeolite process – desalination of brackish water - Reverse Osmosis.

UNIT II SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – contact theory – kinetics of surface reactions, unimolecular reactions, Langmuir - applications of adsorption on pollution abatement.

Catalysis: Catalyst – types of catalysis – criteria – autocatalysis – catalytic poisoning and catalytic promoters - acid base catalysis – applications (catalytic convertor) – enzyme catalysis– Michaelis – Menten equation.

UNIT III ALLOYS AND PHASE RULE 9

Alloys: Introduction- Definition- properties of alloys- significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel. Phase rule: Introduction, definition of terms with examples, one component system -water system - reduced phase rule - thermal analysis and cooling curves - two component systems - lead-silver system - Pattinson process.

UNIT IV FUELS AND COMBUSTION 9

Fuels: Introduction - classification of fuels - coal - analysis of coal (proximate and ultimate) - carbonization - manufacture of metallurgical coke (Otto Hoffmann method) - petroleum - manufacture of synthetic petrol (Bergius process) - knocking - octane number - diesel oil - cetane number - natural gas - compressed natural gas (CNG) - liquefied petroleum gases (LPG) - power alcohol and biodiesel. Combustion of fuels: Introduction - calorific value - higher and lower calorific values- theoretical calculation of calorific value - ignition temperature - spontaneous ignition temperature - explosive range - flue gas analysis (ORSAT Method).

UNIT V ENERGY SOURCES AND STORAGE DEVICES 9

Nuclear fission - controlled nuclear fission - nuclear fusion - differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy - light water nuclear power plant - breeder reactor - solar energy conversion - solar cells - wind energy. Batteries, fuel cells and supercapacitors: Types of

batteries – primary battery (dry cell) secondary battery (lead acid battery, lithium-ion-battery) fuel cells – H_2-O_2 fuel cell.

TOTAL: 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCES:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. Prasanta Rath, "Engineering Chemistry", Cengage Learning India PVT, LTD, Delhi, 2015.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2015.

GE8151 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Allen B. Downey, ‘‘Think Python: How to Think Like a Computer Scientist’’, 2nd edition, Updated for Python 3, Shroff/O’Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, “An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
2. John V Guttag, “Introduction to Computation and Programming Using Python’’, Revised and expanded Edition, MIT Press , 2013
3. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012.
4. Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, “Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
6. Timothy A. Budd, “Exploring Python”, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

GE8152 **ENGINEERING GRAPHICS** **L T P C**
2 0 4 4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination) **1**

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREEHAND SKETCHING **7+12**

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE **6+12**

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS **5+12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **5+12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS **6+12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

TOTAL: 90 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- familiarize with the fundamentals and standards of Engineering graphics
- perform freehand sketching of basic geometrical constructions and multiple views of objects.
- project orthographic projections of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- visualize and to project isometric and perspective sections of simple solids.

TEXT BOOK:

1. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.
3. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy And Vela Murali, “Engineering Graphics”, Oxford University, Press, New Delhi, 2015.
6. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

GE8161	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L T P C 0 0 4 2

COURSE OBJECTIVES:

- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python.

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

COURSE OUTCOMES:

Upon completion of the course, students will be able to

- Write, test, and debug simple Python programs.
- Implement Python programs with conditionals and loops.
- Develop Python programs step-wise by defining functions and calling them.
- Use Python lists, tuples, dictionaries for representing compound data.
- Read and write data from/to files in Python.

TOTAL :60 PERIODS

BS8161	PHYSICS AND CHEMISTRY LABORATORY (Common to all branches of B.E. / B.Tech Programmes)	L T P C 0 0 4 2

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser

(b) Determination of acceptance angle in an optical fiber.

4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

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

- apply principles of elasticity, optics and thermal properties for engineering applications.

CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometery.

1. Estimation of HCl using Na_2CO_3 as primary standard and Determination of alkalinity in water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Determination of CMC.
15. Phase change in a solid.
16. Conductometric titration of strong acid vs strong base.

OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

TOTAL: 30 PERIODS

TEXTBOOKS:

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)

HS8251	TECHNICAL ENGLISH	L	T	P	C
		4	0	0	4

OBJECTIVES: The Course prepares second semester engineering and Technology students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations , participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialisation.

UNIT I INTRODUCTION TECHNICAL ENGLISH 12

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- **Speaking** –Asking for and giving directions- **Reading** – reading short technical texts from journals- newsapapers- **Writing**- purpose statements – extended definitions – issue- writing instructions – checklists-recommendations-**Vocabulary Development**- technical vocabulary **Language Development** –subject verb agreement - compound words.

UNIT II READING AND STUDY SKILLS 12

Listening- Listening to longer technical talks and completing exercises based on them-**Speaking** – describing a process-**Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing- **Writing**- interpreting cgarts, graphs- **Vocabulary Development-**vocabularyused in formal letters/emails and reports **Language Development-** impersonal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING AND GRAMMAR 12

Listening- Listening to classroom lectures/ talkls on engineering/technology -**Speaking** – introduction to technical presentations- **Reading** – longer texts both general and technical, practice in speed reading; **Writing**-Describing a process, use of sequence words- **Vocabulary Development-** sequence words- Misspelled words. **Language Development-** embedded sentences

UNIT IV REPORT WRITING 12

Listening- Listening to documentaries and making notes. **Speaking** – mechanics of presentations- **Reading** – reading for detailed comprehension- **Writing**- email etiquette- job application – cover letter –Résumé preparation(via email and hard copy)- analytical essays and issue based essays-- **Vocabulary Development**- finding suitable synonyms-paraphrasing-. **Language Development-** clauses- if conditionals.

UNIT V GROUP DISCUSSION AND JOB APPLICATIONS 12

Listening- TED/Ink talks; **Speaking** –participating in a group discussion -**Reading**– reading and understanding technical articles **Writing**– Writing reports- minutes of a meeting- accident and survey- **Vocabulary Development- verbal analogies Language Development-** reported speech.

TOTAL : 60 PERIODS

OUTCOMES: At the end of the course learners will be able to:

- Read technical texts and write area- specific texts effortlessly.
- Listen and comprehend lectures and talks in their area of specialisation successfully.
- Speak appropriately and effectively in varied formal and informal contexts.
- Write reports and winning job applications.

TEXT BOOKS:

1. Board of editors. **Fluency in English A Course book for Engineering and Technology.** Orient Blackswan, Hyderabad: 2016.
2. Sudharshana.N.P and Saveetha. C. **English for Technical Communication**. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana**, Project Work,** Oxford University Press**,** Oxford: 2014.
2. Grussendorf, Marion, **English for Presentations,** Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. **Engineering English**. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, **English & Communication For Colleges.** Cengage Learning, USA: 2007
5. Raman, Meenakshi and Sharma, Sangeetha- **Technical Communication Principles and Practice.**Oxford University Press: New Delhi,2014.

Students can be asked to read Tagore, Chetan Bhagat and for suplementary reading.

MA8251 ENGINEERING MATHEMATICS – II

L	T	P	C
4	0	0	4

OBJECTIVES :

- This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I MATRICES **12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II VECTOR CALCULUS **12**

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved

surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTIONS 12

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions $w = z + c, cz, \frac{1}{z}, z^2$ - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V LAPLACE TRANSFORMS 12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

OUTCOMES :

- After successfully completing the course, the student will have a good understanding of the following topics and their applications:

  - Eigenvalues and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
  - Gradient, divergence and curl of a vector point function and related identities.
  - Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
  - Analytic functions, conformal mapping and complex integration.
  - Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES :

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

4. Sastry, S.S, “Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PH8253	PHYSICS FOR ELECTRONICS ENGINEERING	L	T	P	C
	(Common to BME, ME, CC, ECE, EEE, E&I, ICE)	3	0	0	3

OBJECTIVES:

- To understand the essential principles of Physics of semiconductor device and Electron transport properties. Become proficient in magnetic, dielectric and optical properties of materials and nano devices.

UNIT I ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity – Thermal conductivity, expression - Wiedemann-Franz law – Success and failures - electrons in metals – Particle in a three dimensional box – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential: Bloch thorem – metals and insulators - Energy bands in solids– tight binding approximation - Electron effective mass – concept of hole.

UNIT II SEMICONDUCTOR PHYSICS 9

Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Carrier transport: Velocity-electric field relations – drift and diffusion transport - Einstein’s relation – Hall effect and devices – Zener and avalanche breakdown in p-n junctions - Ohmic contacts – tunnel diode - Schottky diode – MOS capacitor - power transistor.

UNIT III MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9

Magnetism in materials – magnetic field and induction – magnetization - magnetic permeability and susceptibility–types of magnetic materials – microscopic classification of magnetic materials - Ferromagnetism: origin and exchange interaction- saturation magnetization and Curie temperature – Domain Theory. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation- dielectric breakdown – high-k dielectrics.

UNIT IV OPTICAL PROPERTIES OF MATERIALS 9

Classification of optical materials – carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and Semiconductors (concepts only) - photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED – Laser diodes – excitons - quantum confined Stark effect – quantum dot laser.

UNIT V NANOELECTRONIC DEVICES 9

Introduction - electron density in bulk material – Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures –Zener-Bloch oscillations – resonant tunneling – quantum interference effects – mesoscopic structures: conductance fluctuations and coherent transport – Coulomb blockade effects - Single electron phenomena and Single electron Transistor – magnetic semiconductors– spintronics - Carbon nanotubes: Properties and applications.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the students will able to

- gain knowledge on classical and quantum electron theories, and energy band structuues,
- acquire knowledge on basics of semiconductor physics and its applications in various devices,
- get knowledge on magnetic and dielectric properties of materials,
- have the necessary understanding on the functioning of optical materials for optoelectronics,
- understand the basics of quantum structures and their applications in spintronics and carbon electronics.

TEXT BOOKS:

1. Kasap, S.O. “Principles of Electronic Materials and Devices”, McGraw-Hill Education, 2007.
2. Umesh K Mishra & Jasprit Singh, “Semiconductor Device Physics and Design”, Springer, 2008.
3. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa Publishing House, 2009.

REFERENCES

1. Garcia, N. & Damask, A. “Physics for Computer Science Students”. Springer-Verlag, 2012.
2. Hanson, G.W. “Fundamentals of Nanoelectronics”. Pearson Education, 2009
3. Rogers, B., Adams, J. & Pennathur, S. “Nanotechnology: Understanding Small Systems”. CRC Press, 2014

BE8252 BASIC CIVIL AND MECHANICAL ENGINEERING L T P C
4 0 0 4

OBJECTIVES:

- To impart basic knowledge on Civil and Mechanical Engineering.
- To familiarize the materials and measurements used in Civil Engineering.
- To provide the exposure on the fundamental elements of civil engineering structures.
- To enable the students to distinguish the components and working principle of power plant units, IC engines, and R & AC system.

A – OVER VIEW

UNIT I SCOPE OF CIVIL AND MECHANICAL ENGINEERING 10

Overview of Civil Engineering - Civil Engineering contributions to the welfare of Society – Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering

Overview of Mechanical Engineering - Mechanical Engineering contributions to the welfare of Society –Specialized sub disciplines in Mechanical Engineering - Production, Automobile, Energy Engineering - Interdisciplinary concepts in Civil and Mechanical Engineering.

B – CIVIL ENGINEERING

UNIT II SURVEYING AND CIVIL ENGINEERING MATERIALS 10

Surveying: Objects – classification – principles – measurements of distances – angles – leveling – determination of areas– contours - examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel - timber - modern materials

UNIT III BUILDING COMPONENTS AND STRUCTURES 15

Foundations: Types of foundations - Bearing capacity and settlement – Requirement of good foundations.

Civil Engineering Structures: Brickmasonry – stonemasonry – beams – columns – lintels – roofing – flooring – plastering – floor area, carpet area and floor space index - Types of Bridges and Dams – water supply - sources and quality of water - Rain water harvesting - introduction to high way and rail way.

C – MECHANICAL ENGINEERING

UNIT IV INTERNAL COMBUSTION ENGINES AND POWER PLANTS 15

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants –- working principle of Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

OUTCOMES:

On successful completion of this course, the student will be able to

- appreciate the Civil and Mechanical Engineering components of Projects.
- explain the usage of construction material and proper selection of construction materials.
- measure distances and area by surveying
- identify the components used in power plant cycle.
- demonstrate working principles of petrol and diesel engine.
- elaborate the components of refrigeration and Air conditioning cycle.

TOTAL: 60 PERIODS

TEXTBOOKS:

1. Shanmugam Gand Palanichamy MS,“Basic Civil and Mechanical Engineering”,Tata McGraw Hill PublishingCo.,NewDelhi,1996.

REFERENCES:

1. Palanikumar, K. Basic Mechanical Engineering, ARS Publications, 2010.
2. Ramamrutham S.,“Basic Civil Engineering”, Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Seetharaman S.,“BasicCivil Engineering”,AnuradhaAgencies,2005.
4. ShanthaKumar SRJ.,“Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai, 2000.
5. Venugopal K. and Prahu Raja V., “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam,2000.

EE8251	CIRCUIT THEORY	L	T	P	C
		2	2	0	3

OBJECTIVES:

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To introduce the phenomenon of resonance in coupled circuits.
- To educate on obtaining the transient response of circuits.
- To introduce Phasor diagrams and analysis of three phase circuits

UNIT I BASIC CIRCUITS ANALYSIS 6+6

Resistive elements - Ohm's Law Resistors in series and parallel circuits – Kirchoffs laws – Mesh current and node voltage - methods of analysis.

UNIT II NETWORK REDUCTION AND THEOREMS FOR DC AND AC IRCUITS 6+6

Network reduction: voltage and current division, source transformation – star delta conversion. Thevenins and Norton Theorems – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem – Millman's theorem.

UNIT III TRANSIENT RESPONSE ANALYSIS 6+6

L and C elements -Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.

UNIT IV THREE PHASE CIRCUITS 6+6

A.C. circuits – Average and RMS value - Phasor Diagram – Power, Power Factor and Energy.- Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power measurement in three phase circuits.

UNIT V RESONANCE AND COUPLED CIRCUITS 6+6

Series and parallel resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

TOTAL : 60 PERIODS

OUTCOMES:

- Ability to analyse electrical circuits
- Ability to apply circuit theorems
- Ability to analyse transients

TEXT BOOKS:

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.
3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCES

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New

Delhi, 1999.
2. Jegatheesan, R., “Analysis of Electric Circuits,” McGraw Hill, 2015.
3. Joseph A. Edminister, Mahmood Nahri, “Electric circuits”, Schaum’s series, McGraw-Hill, New Delhi, 2010.
4. M E Van Valkenburg, “Network Analysis”,Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
5. Mahadevan, K., Chitra, C., “Electric Circuits Analysis,” Prentice-Hall of India Pvt Ltd., New Delhi, 2015.
6. Richard C. Dorf and James A. Svoboda, “Introduction to Electric Circuits”, 7th Edition, John Wiley & Sons, Inc. 2015.
7. Sudhakar A and Shyam Mohan SP, “Circuits and Network Analysis and Synthesis”, McGraw Hill, 2015.

GE8291 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth‟s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone

and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXTBOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES :

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

GE8261 ENGINEERING PRACTICES LABORATORY L T P C
0 0 4 2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 13

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.
(b) Study of pipe connections requirements for pumps and turbines.
(c) Preparation of plumbing line sketches for water supply and sewage works.
(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.
(b) Hands-on-exercise:
Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 18

Welding:

(a) Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.
(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning
(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:
(b) Model making – Trays and funnels.
(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump
(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.
(b) Foundry operations like mould preparation for gear and step cone pulley.
(c) Fitting – Exercises – Preparation of square fitting and V – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 13

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 16

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of this course, the student will be able to

- fabricate carpentry components and pipe connections including plumbing works.
- use welding equipments to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metal works
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundary and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

ELECTRONICS

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

EE8261 ELECTRIC CIRCUITS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To simulate various electric circuits using Pspice/ Matlab/e-Sim / Scilab
- To gain practical experience on electric circuits and verification of theorems.

LIST OF EXPERIMENTS

1. Simulation and experimental solving of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Simulation and experimental solving of electrical circuit problems using Thevenin's theorem.
3. Simulation and experimental solving of electrical circuit problems using Norton's theorem.
4. Simulation and experimental solving of electrical circuit problems using Superposition

theorem.

5. Simulation and experimental verification of Maximum Power transfer Theorem.
6. Study of Analog and digital oscilloscopes and measurement of sinusoidal voltage, frequency and power factor.
7. Simulation and Experimental validation of R-C electric circuit transience.
8. Simulation and Experimental validation of frequency response of RLC electric circuit.
9. Design and Simulation of series resonance circuit.
10. Design and Simulation of parallel resonant circuits.
11. Simulation of three phase balanced and unbalanced star, delta networks circuits.

TOTAL: 60 PERIODS

OUTCOMES:

- Understand and apply circuit theorems and concepts in engineering applications.
- Simulate electric circuits.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1	Regulated Power Supply: 0 – 15 V D.C - 10 Nos / Distributed Power Source.
2	Function Generator (1 MHz) - 10 Nos.
3	Single Phase Energy Meter - 1 No.
4	Oscilloscope (20 MHz) - 10 Nos.
5	Digital Storage Oscilloscope (20 MHz) – 1 No.
6	10 Nos of PC with Circuit Simulation Software (min 10 Users) (e-Sim / Scilab/ Pspice / Matlab /other Equivalent software Package) and Printer (1 No.)
7	AC/DC - Voltmeters (10 Nos.), Ammeters (10 Nos.) and Multi-meters (10 Nos.) 8 Single Phase Wattmeter – 3 Nos.
9	Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box Each - 6 Nos.
10	Circuit Connection Boards - 10 Nos.

Necessary Quantities of Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)

MA8353 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
4	0	0	4

OBJECTIVES :

- To introduce the basic concepts of PDE for solving standard partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations – Singular integrals - Solutions of standard types of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 12

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

TOTAL : 60 PERIODS

OUTCOMES :

Upon successful completion of the course, students should be able to:

- Understand how to solve the given standard partial differential equations.
- Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
- Appreciate the physical significance of Fourier series techniques in solving one and two dimensional heat flow problems and one dimensional wave equations.
- Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.
- Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS :

1. Grewal B.S., “Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES :

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

EC8353 ELECTRON DEVICES AND CIRCUITS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the structure of basic electronic devices.
- Be exposed to active and passive circuit elements.
- Familiarize the operation and applications of transistor like BJT and FET.
- Explore the characteristics of amplifier gain and frequency response.
- Learn the required functionality of positive and negative feedback systems.

UNIT I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes, Zener diodecharacteristics- Zener Reverse characteristics – Zener as regulator

UNIT II TRANSISTORS AND THYRISTORS 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristors and IGBT - Structure and characteristics.

UNIT III AMPLIFIERS 9

BJT small signal model – Analysis of CE, CB, CC amplifiers- Gain and frequency response – MOSFET small signal model– Analysis of CS and Source follower – Gain and frequency response- High frequency analysis.

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response – Neutralization methods, power amplifiers –Types (Qualitative analysis).

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series , Shunt feedback –positive feedback – Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL : 45 PERIODS

OUTCOMES:

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

- Explain the structure and working operation of basic electronic devices.
- Able to identify and differentiate both active and passive elements
- Analyze the characteristics of different electronic devices such as diodes and transistors
- Choose and adapt the required components to construct an amplifier circuit.
- Employ the acquired knowledge in design and analysis of oscillators

TEXT BOOKS:

1. . David A. Bell ,"Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits",7th Ed., Oxford University Press

REFERENCES:

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition 2014.
2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.
3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.
4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.
5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004.

EE8351	DIGITAL LOGIC CIRCUITS	L	T	P	C
		2	2	0	3

OBJECTIVES:

- To study various number systems and simplify the logical expressions using Boolean functions
- To study combinational circuits
- To design various synchronous and asynchronous circuits.
- To introduce asynchronous sequential circuits and PLDs
- To introduce digital simulation for development of application oriented logic circuits.

UNIT I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 6+6

Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.

UNIT II COMBINATIONAL CIRCUITS 6+6

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 6+6

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Melay models- Counters, state diagram; state reduction; state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES 6+6

Asynchronous sequential logic circuits-Transition tability, flow tability-race conditions, hazards &errors in digital circuits; analysis of asynchronous sequential logic circuits-introduction to Programmability Logic Devices: PROM – PLA –PAL, CPLD-FPGA.

UNIT V VHDL 6+6

RTL Design – combinational logic – Sequential circuit – Operators – Introduction to Packages – Subprograms – Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

TOTAL : 60 PERIODS

OUTCOMES:

- Ability to design combinational and sequential Circuits.
- Ability to simulate using software package.
- Ability to study various number systems and simplify the logical expressions using Boolean functions
- Ability to design various synchronous and asynchronous circuits.
- Ability to introduce asynchronous sequential circuits and PLDs
- Ability to introduce digital simulation for development of application oriented logic circuits.

TEXT BOOKS:

1. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.
2. M. Morris Mano, 'Digital Design with an introduction to the VHDL', Pearson Education, 2013.
3. Comer "Digital Logic & State Machine Design, Oxford, 2012.

REFERENCES

1. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
2. William Keitz, Digital Electronics-A Practical Approach with VHDL, Pearson, 2013.
3. Thomas L.Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
4. Charles H.Roth, Jr, Lizy Lizy Kurian John, 'Digital System Design using VHDL, Cengage, 2013.
5. D.P.Kothari,J.S.Dhillon, 'Digital circuits and Design',Pearson Education, 2016.

EI8351 ELECTRICAL MEASUREMENTS L T P C
2 2 0 3

OBJECTIVES:

- To introduce the meters used to measure current & voltage.
- To have an adequate knowledge in the measurement techniques for power and energy, power and energy meters are included.
- To provide Elaborate discussion about potentiometer & instrument transformers.
- To provide Detailed study of resistance measuring methods.
- To provide Detailed study of inductance and capacitance measurement.

UNIT I MEASUREMENT OF VOLTAGE AND CURRENT 6+6

Galvanometers: – Ballistic, D'Arsonval galvanometer – Theory, calibration, application – Principle, construction, operation and comparison of moving coil, moving iron meters, dynamometer, induction type & thermal type meter, rectifier type – Extension of range and calibration of voltmeter and ammeter – Errors and compensation.

UNIT II MEASUREMENT OF POWER AND ENERGY 6+6

Electrodynamometer type wattmeter: – Theory & its errors – Methods of correction – LPF wattmeter– Phantom loading – Induction type kWh meter – Induction type energy meter – Calibration of wattmeter and Energy meter.

UNIT III POTENTIOMETERS & INSTRUMENT TRANSFORMERS 6+6

DC potentiometer:– Basic circuit, standardization – Laboratory type (Crompton's) – AC potentiometer:-Drysdale (polar type) type – Gall-Tinsley (coordinate) type – Limitations & applications – Instrument Transformer:-C.T and P.T construction, theory, operation and characteristics.

UNIT IV RESISTANCE MEASUREMENT 6+6

Measurement of low, medium & high resistance: – Ammeter, voltmeter method – Wheatstone bridge– Kelvin double bridge – Series and shunt type ohmmeter – High resistance measurement :-Loss of charge method, Megohm bridge method –Megger – Direct deflection methods – Price's guard-wiremethod – Earth resistance measurement.

UNIT V IMPEDANCE MEASUREMENT 6+6

A.C bridges:– Measurement of inductance, capacitance – Q of coil – Maxwell Bridge – Wein's bridge– Schering bridge – Anderson bridge –Hay's bridge- Campbell bridge to measure mutual inductance – Errors in A.C. bridge methods and their compensation – Detectors – Excited field – A.C. galvanometer– Vibration galvanometer.

TOTAL:60 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

1. Ability to measure current and voltage,
2. Ability to understand AC and DC measurements.
3. Ability to measure power and calibration of energy meters.
4. Ability to measure current and voltage using potentiometric method.
5. Ability to understand the resistance measurement
6. Ability to use bridge circuit to measure resistance, inductance and capacitance.

TEXT BOOKS

1. E.W. Golding &F.C.Widdis, 'Electrical Measurements & Measuring Instruments', A.H.Wheeler& Co, 2001

2. H.S. Kalsi, Electronic Instrumentation, McGraw-Hill Education, New Delhi, 2010

REFERENCES

1. A.K. Sawhney, A Course in Electrical & Electronic Measurements & Instrumentation, Dhanpat Rai and Co, New Delhi, 2010.
2. S.K.Singh, 'Industrial Instrumentation and control', Tata McGraw Hill, 2nd edn., 2002.
3. J.B.Gupta, 'A Course in Electronic and Electrical Measurements and Instrumentation',S.K.Kataria& Sons, Delhi, 2003.
4. Martin U. Reissland, 'Electrical Measurement – Fundamental Concepts and Applications', New Age International (P) Ltd., 2001.
5. R.B. Northrop, Introduction to Instrumentation and Measurements, Taylor & Francis, New Delhi, 2008.
6. M.M.S. Anand, "Electronics Instruments and Instrumentation Technology", Prentice Hall India, NewDelhi, 2009.
7. J.J. Carr, "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.

EI8352 TRANSDUCERS ENGINEERING L T P C
3 0 0 3

COURSE OBJECTIVES

- Get to know the methods of measurement, classification of transducers and to analyze error.
- To understand the behavior of transducers under static and dynamic conditions and hence to model the transducer.
- Get exposed to different types of resistive transducers and their application areas.
- To acquire knowledge on capacitive and inductive transducers.
- To gain knowledge on variety of transducers and get introduced to MEMS and Smart transducers.

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Units and standards – Static calibration – Classification of errors, Limiting error and probable error – Error analysis – Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: - Accuracy, precision, resolution, sensitivity, linearity, span and range. Dynamic characteristics: Mathematical model of transducer, Zero, I and II order transducers, Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezo-resistive sensor and humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details, characteristics of capacitive transducers – Different types & Signal Conditioning – Applications:- Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

UNIT V OTHER TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors – Thick & Thin Film sensors (Bio sensor & Chemical Sensor) – Environmental Monitoring sensors (Water Quality & Air pollution) – Introduction to MEMS – Introduction to Smart transducers and its interface standard (IEEE 1451).

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the ability:

1. Ability to apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.
2. Ability to analyze the problems related to sensors & transducers.
3. Ability to select the right sensor/transducer for a given application.
4. Ability to determine the static and dynamic characteristics of transducers using software packages.
5. Ability to understand fiber optic sensor and applications.
6. Ability to understand smart traducer and its standard.

TEXT BOOKS

1. Doebelin E.O. and Manik D.N., “Measurement Systems”, 6th Edition, McGraw-Hill Education Pvt. Ltd., 2011.
2. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003

REFERENCES

1. Bela G.Liptak, Instrument Engineers’ Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
2. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.
3. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2000.
4. W.Bolton, Engineering Science, Elsevier Newnes, Fifth edition, 2006.
5. Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
6. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012.

CS8392 OBJECT ORIENTED PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

- To understand Object Oriented Programming concepts and basic characteristics of Java
- To know the principles of packages, inheritance and interfaces
- To define exceptions and use I/O streams
- To develop a java application with threads and generics classes
- To design and build simple Graphical User Interfaces

UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 10

Object Oriented Programming - Abstraction – objects and classes - Encapsulation- Inheritance - Polymorphism- OOP in Java – Characteristics of Java – The Java Environment **-** Java Source File -Structure – Compilation. Fundamental Programming Structures in Java – Defining classes in Java – constructors, methods -access specifiers - static members -Comments, Data Types, Variables, Operators, Control Flow, Arrays , Packages - JavaDoc comments.

UNIT II INHERITANCE AND INTERFACES 9

Inheritance – Super classes- sub classes –Protected members – constructors in sub classes- the Object class – abstract classes and methods- final methods and classes – Interfaces – defining an interface, implementing interface, differences between classes and interfaces and extending interfaces - Object cloning -inner classes, Array Lists - Strings

UNIT III EXCEPTION HANDLING AND I/O 9

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements. Input / Output Basics – Streams – Byte streams and Character streams – Reading and Writing Console – Reading and Writing Files

UNIT IV MULTITHREADING AND GENERIC PROGRAMMING 8

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups. Generic Programming – Generic classes – generic methods – Bounded Types – Restrictions and Limitations.

UNIT V EVENT DRIVEN PROGRAMMING 9

Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy - Introduction to Swing – layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists- choices- Scrollbars – Windows –Menus – Dialog Boxes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Develop Java programs using OOP principles
- Develop Java programs with the concepts inheritance and interfaces
- Build Java applications using exceptions and I/O streams
- Develop Java applications with threads and generics classes
- Develop interactive Java programs using swings

TEXT BOOKS

1. Herbert Schildt, “Java The complete reference”, 8th Edition, McGraw Hill Education, 2011.
2. Cay S. Horstmann, Gary cornell, “Core Java Volume –I Fundamentals”, 9th Edition, Prentice Hall, 2013.

REFERENCES

1. Paul Deitel, Harvey Deitel, "Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
2. Steven Holzner, "Java 2 Black book", Dreamtech press, 2011.
3. Timothy Budd, "Understanding Object-oriented programming with Java", Updated Edition, Pearson Education, 2000.

EI8361 MEASUREMENTS AND TRANSDUCERS LABORATORY 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.
- To make the students conscious about static and dynamic characteristics of different types of transducer.
- To make the students to analyze step response of RTD
- To the student to measure resistance using bridge circuits
- To make the students to calibrate the electrical instruments

LIST OF EXPERIMENTS

1. Displacement versus output voltage characteristics of a potentiometric transducer.
2. Characteristics of Strain gauge and Load cell.
3. Characteristics of LVDT, Hall Effect transducer and Photoelectric tachometer.
4. Characteristics of LDR, thermistor and thermocouple (J, K, E types).
5. Step response characteristic of RTD and thermocouple.
6. Temperature measurements using RTD with three and four leads.
7. Wheatstone and Kelvin's bridge for measurement of resistance.
8. Schering Bridge for capacitance measurement and Anderson Bridge for inductance measurement.
9. Measurement of Angular displacement using resistive and Capacitive transducer.
10. Calibration of Single-phase Energy meter and wattmeter.
11. Calibration of Ammeter and Voltmeter using Shunt type potentiometer.

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Understand the concepts of measurement, error and uncertainty.
2. Understand the static and dynamic characteristics of measuring instruments.
3. Gain knowledge about the principle of operation and characteristics of different types of resistance, capacitance and inductance transducers.
4. Acquire knowledge of analyzing different stages of signal conditioning units.
5. Ability to interpret the results and draw meaningful conclusions.
6. Ability to work as a member of a team while carrying out experiments.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Experimental setup for
Measurement of Linear displacement using Potentiometer
Strain gauge and Load cell characterisation and application
LVDT characterisation and application
Hall Effect characterisation and application
Measurement of Angular displacement
Muffle furnace
Thermistor characterisation and application
Various types of Thermocouple and RTD characterisation and application
Measurement of power and energy
Sufficient number of power supply, Galvanometer, Bread board, Multimeter, resistors, Decade Capacitance box, Decade resistance box, Decade Inductance box, CRO.

CS8383	**OBJECT ORIENTED PROGRAMMING LABORATORY**	**L T P C 0 0 4 2**

COURSE OBJECTIVES

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, arraylist, exception handling and file processing.
- To develop applications using generic programming and event handling.

List of experiments

1. Develop a Java application to generate Electricity bill. Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection(i.e domestic or commercial). Compute the bill amount using the following tariff.
   If the type of the EB connection is domestic, calculate the amount to be paid as follows:
   - First 100 units - Rs. 1 per unit
   - 101-200 units - Rs. 2.50 per unit
   - 201 -500 units - Rs. 4 per unit
   - > 501 units - Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:

- First 100 units - Rs. 2 per unit

- 101-200 units - Rs. 4.50 per unit
- 201 -500 units - Rs. 6 per unit
- > 501 units - Rs. 7 per unit

2. Develop a java application to implement currency converter (Dollar to INR, EURO to INR, Yen to INR and vice versa), distance converter (meter to KM, miles to KM and vice versa) , time converter (hours to minutes, seconds and vice versa) using packages.
3. Develop a java application with Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club fund. Generate pay slips for the employees with their gross and net salary.
4. Design a Java interface for ADT Stack. Implement this interface using array. Provide necessary exception handling in both the implementations.
5. Write a program to perform string operations using ArrayList. Write functions for the following

   a. Append - add at end
   b. Insert – add at particular index
   c. Search
   d. List all string starts with given letter
6. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named print Area(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method print Area () that prints the area of the given shape.
7. Write a Java program to implement user defined exception handling.
8. Write a Java program that reads a file name from the user, displays information about whether the file exists, whether the file is readable, or writable, the type of file and the length of the file in bytes.
9. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.
10. Write a java program to find the maximum value from the given type of elements using a generic function.
11. Design a calculator using event-driven programming paradigm of Java with the following options.

    a) Decimal manipulations
    b) Scientific manipulations
12. Develop a mini project for any application using Java concepts.

TOTAL : 60 PERIODS

COURSE OUTCOMES

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

- Develop and implement Java programs for simple applications that make use of classes, packages and interfaces.
- Develop and implement Java programs with arraylist, exception handling and multithreading .
- Design applications using file processing, generic programming and event handling.

MA8491 **NUMERICAL METHODS** **L T P C**
4 0 0 4

OBJECTIVES :

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi's method for symmetric matrices.

UNIT II INTERPOLATION AND APPROXIMATION 12

Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation – Cubic Splines - Difference operators and relations - Interpolation with equal intervals - Newton's forward and backward difference formulae.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Romberg's Method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order equations - Multi step methods - Milne's and Adams - Bash forth predictor corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 12

Finite difference methods for solving second order two - point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit and implicit (Crank Nicholson) methods – One dimensional wave equation by explicit method.

TOTAL : 60 PERIODS

OUTCOMES :

Upon successful completion of the course, students should be able to:

- Understand the basic concepts and techniques of solving algebraic and transcendental equations.
- Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
- Apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXTBOOKS :

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.

REFERENCES :

1. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
2. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
3. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

EI8451 ELECTRICAL MACHINES L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the principles of operations of DC machines as motor and generator
- To introduce the principles of operations of Transformers
- To introduce the principles of operations of Induction machines
- To introduce the principles of operations of Synchronous machines
- To introduce other special machines

UNIT I D.C. MACHINES 9

D.C. Machines: – Principle of operation and construction of motor and generator – torque equation – Various excitation schemes – Characteristics of Motor and Generator – Starting, Speed control of D.C. Motor.

UNIT II TRANSFORMERS 9

Principle, Construction and Types of Transformer - EMF equation - Phasor diagrams - Regulation and efficiency of a transformer-Introduction to three phase transformer Connection. Applications of Current and Potential Transformer.

UNIT III SYNCHRONOUS MACHINES 9

Principle of Operation, type - EMF Equation and Phasor diagrams - Synchronous motor- Rotating Magnetic field Starting Methods , Torque V- Curves, inverted – V curves.

UNIT IV THREE PHASE INDUCTION MOTORS 9

Induction motor-principle of operation, Types - Torque-slip characteristics - Starting methods and Speed control of induction motors.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Types of single phase induction motors –Double field revolving theory- Capacitor start capacitor run motors – Shaded pole motor – Repulsion type motor – Universal motor – Hysteresis motor - Switched reluctance motor – Brushless D.C motor.-Stepper motor.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the:

1. Ability to acquire knowledge to solve problems associated with DC and AC Machines.
2. Ability to test and control different machines based on the familiarity of basic concepts and working principle.
3. Ability to choose appropriate machines for a given application while carrying out projects.
4. Ability to apply the knowledge gained to choose appropriate machines for specific application useful for the society.
5. Ability to know about the latest developments related to machines and to learn their concepts even after the completion of the course.
6. Ability to acquire knowledge of stepper motor.

TEXT BOOKS

1. Fitzgerald A.E, Kingsley C., Umans, S. and Umans S.D., “Electric Machinery”, McGraw-Hill, 2002.
2. Theraja, B.L., “A Text book of Electrical Technology”, Vol.II, S.C Chand and Co., New Delhi, 2007.

REFERENCES

1. Abhijit Chakrabarti and Sudipta Debnath, “Electrical Machines”, McGraw- Hill Education, 2015.
2. Deshpande M. V., “Electrical Machines” PHI Learning Pvt. Ltd., New Delhi, 2011
3. B.S.Guru and H.R.Hiziroglu, “Electric Machinery and Transformer’, Oxford university Press 2007
4. Del Toro, V., “Electrical Engineering Fundamentals”, Prentice Hall of India, New Delhi, 1995.
5. Nagrath I. J and Kothari D. P. ‘Electric Machines’, Fourth Edition, McGraw Hill Education, 2010.
6. C.A.Gross, “Electric Machines”, CRC Press 2010.
7. NPTEL Video Lecture series on “Electrical Machines I” and “Electrical Machines II” by Dr. Krishna Vasudevan, IIT Madras.

EI8452 INDUSTRIAL INSTRUMENTATION - I L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the measurement techniques of force, torque and speed.
- To introduce the measurement techniques of acceleration, Vibration and density
- To introduce the measurement Viscosity, Humidity and moisture.
- To introduce the temperature measurement techniques
- To introduce the pressure measurement techniques

UNIT I MEASUREMENT OF FORCE, TORQUE AND SPEED 8

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 tacho, Drag cup type tacho, D.C and A.C tacho generators - Stroboscope.

UNIT II MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY 8

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

UNIT III MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE 8

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 IV TEMPERATURE MEASUREMENT 12

Definitions and standards – Primary and secondary fixed points – Different types of filled in system thermometers – Sources of errors in filled in systems and their compensation – Bimetallic thermometers – IC sensors – Thermocouples: Laws of thermocouple, Fabrication of industrial thermocouples, Reference junctions compensation, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation, Response of thermocouple, Special techniques for measuring high temperature using thermocouple – Radiation fundamentals - Radiation methods of temperature measurement – Total radiation pyrometers – Optical pyrometers – Two color radiation pyrometers – Fiber optic sensor for temperature measurement – Thermograph, Temperature switches and thermostats – Temperature sensor selection, Installation and Calibration.

UNIT V PRESSURE MEASUREMENT 9

Units of pressure – Manometers: Different 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, lionization gauges, Cold cathode type and hot cathode type – Pressure gauge selection, installation and calibration using dead weight tester.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student will have the:

1. Ability to understand the construction and working of instruments used for measurement of force, torque, speed, acceleration, vibration, density, viscosity, humidity, moisture, temperature.
2. Ability to select instruments according to the application.
3. Ability to understand the concept of calibration of instruments and gain knowledge about temperature measurement devices.
4. Ability to design signal conditioning circuits and compensation schemes for temperature measuring instruments.
5. Ability to understand the working of instruments used for measurement of pressure.
6. Ability to measure fiber optic sensor to measure temperature.

TEXT BOOKS

1. Doebelin, E.O. and Manik, D.N., "Measurement systems Application and Design", 6th McGraw-Hill Education Pvt. Ltd, 2011.
2. Jones, B.E., "Instrument Technology", Vol.2, Butterworth-Heinemann, International Edition, 2003.

REFERENCES

1. Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press, 2005.
2. Patranabis, D., "Principles of Industrial Instrumentation", 3rd Edition, McGraw-Hill Education, 2017.
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.
5. Alok Barua, "Lecture Notes on Industrial Instrumentation", NPTEL, E-Learning Course, IIT Kharagpur.
6. Jayashankar, V., "Lecture Notes on Industrial Instrumentation", NPTEL, E-Learning Course, IIT Madras.
7. A.K. Sawhney, "A Course in Electronic Measurements and Instrumentation ", Dhanpat Rai & Co. (P) Limited, 2015.

EE8451	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following topics

- Signal analysis using Op-amp based circuits.
- Applications of Op-amp.
- Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- IC fabrication procedure.

UNIT I IC FABRICATION 9

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realisation of monolithic ICs and packaging. Fabrication of

diodes, capacitance, resistance, FETs and PV Cell.

UNIT II CHARACTERISTICS OF OPAMP 9

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp – Inverting and Non-inverting Amplifiers, summer, differentiator and integrator-V/I & I/V converters.

UNIT III APPLICATIONS OF OPAMP 9

Instrumentation amplifier and its applications for transducer Bridge, Log and Antilog Amplifiers- Analog multiplier & Divider, first and second order active filters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R- 2R ladder and weighted resistor types), A/D converters using opamps.

UNIT IV SPECIAL ICs 9

Functional block, characteristics of 555 Timer and its PWM application - IC-566 voltage controlled oscillator IC; 565-phase locked loop IC, AD633 Analog multiplier ICs.

UNIT V APPLICATION ICs 9

AD623 Instrumentation Amplifier and its application as load cell weight measurement - IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variable voltage regulators, switching regulator- SMPS - ICL 8038 function generator IC.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to acquire knowledge in IC fabrication procedure
- Ability to analyze the characteristics of Op-Amp
- To understand the importance of Signal analysis using Op-amp based circuits.
- Functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.
- To understand and acquire knowledge on the Applications of Op-amp
- Ability to understand and analyse, linear integrated circuits their Fabrication and Application.

TEXT BOOKS:

1. David A. Bell, ‘Op-amp & Linear ICs’, Oxford, 2013.
2. D. Roy Choudhary, Sheil B. Jani, ‘Linear Integrated Circuits’, II edition, New Age, 2003.
3. Ramakant A.Gayakward, ‘Op-amps and Linear Integrated Circuits’, IV edition, Pearson Education, 2003 / PHI. 2000.

REFERENCES

1. Fiore,”Opamps & Linear Integrated Circuits Concepts & applications”, Cengage, 2010.
2. Floyd ,Buchla,”Fundamentals of Analog Circuits, Pearson, 2013.
3. Jacob Millman, Christos C.Halkias, ‘Integrated Electronics - Analog and Digital circuits system’, McGraw Hill, 2003.
4. Robert F.Coughlin, Fredrick F. Driscoll, ‘Op-amp and Linear ICs’, Pearson, 6th edition,2012.
5. Sergio Franco, ‘Design with Operational Amplifiers and Analog Integrated Circuits’, Mc Graw Hill, 2016.
6. Muhammad H. Rashid,’ Microelectronic Circuits Analysis and Design’ Cengage Learning, 2011.

IC8451 **CONTROL SYSTEMS** **LT P C**

3 2 0 4

COURSE OBJECTIVES

- To understand the use of transfer function models for analysis physical systems and introduce the control system components.
- To provide adequate knowledge in the time response of systems and steady state error analysis.
- To accord basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- To introduce stability analysis and design of compensators
- To introduce state variable representation of physical systems

UNIT I SYSTEMS AND REPRESENTATION 9

Basic elements in control systems: – Open and closed loop systems – Electrical analogy of mechanical and thermal systems – Transfer function – AC and DC servomotors – Block diagram reduction techniques – Signal flow graphs.

UNIT II TIME RESPONSE 9

Time response: – Time domain specifications – Types of test input – I and II order system response – Error coefficients – Generalized error series – Steady state error – Root locus construction- Effects of P, PI, PID modes of feedback control –Time response analysis.

UNIT III FREQUENCY RESPONSE 9

Frequency response: – Bode plot – Polar plot – Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications

UNIT IV STABILITY AND COMPENSATOR DESIGN 9

Characteristics equation – Routh Hurwitz criterion – Nyquist stability criterion- Performance criteria – Effect of Lag, lead and lag-lead compensation on frequency response-Design of Lag, lead and lag-lead compensator using bode plots.

UNIT V STATE VARIABLE ANALYSIS 9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

TOTAL (L: 45+T:30):75 PERIODS

COURSE OUTCOMES

At the end of the course, the student should have the :

- Ability to develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.
- Ability to do time domain and frequency domain analysis of various models of linear system.
- Ability to interpret characteristics of the system to develop mathematical model.
- Ability to design appropriate compensator for the given specifications.
- Ability to come out with solution for complex control problem.
- Ability to understand use of PID controller in closed loop system.

TEXT BOOKS

1. Nagarath, I.J. and Gopal, M., “Control Systems Engineering”, New Age International Publishers, 2017.
2. Benjamin C. Kuo, “Automatic Control Systems”, Wiley, 2014.

REFERENCES

1. Katsuhiko Ogata, “Modern Control Engineering”, Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., “Modern Control Systems”, Pearson Education,2009.
3. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, CRC Taylor& Francis Reprint 2009.
4. Rames C.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification and Control of Engineers”, Narosa Publishing House, 2017.
5. M.Gopal, “Control System: Principle and design”, McGraw Hill Education, 2012.
6. NPTEL Video Lecture Notes on “Control Engineering “by Prof. S. D. Agashe, IIT Bombay.

EC8395 COMMUNICATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To study the various analog and digital modulation techniques
- To study the principles behind information theory and coding
- To study the various digital communication techniques

UNIT I ANALOG MODULATION 9

Amplitude Modulation – AM, DSBSC, SSBSC, VSB – PSD, modulators and demodulators – Angle modulation – PM and FM – PSD, modulators and demodulators – Superheterodyne receivers

UNITII PULSE MODULATION 9

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM And ADM, Channel Vocoder - Time Division Multiplexing, Frequency Division Multiplexing

UNIT III DIGITAL MODULATION AND TRANSMISSION 9

Phase shift keying – BPSK, DPSK, QPSK – Principles of M-ary signaling M-ary PSK & QAM – Comparison, ISI – Pulse shaping – Duo binary encoding – Cosine filters – Eye pattern, equalizers

UNIT IV INFORMATION THEORY AND CODING 9

Measure of information – Entropy – Source coding theorem – Shannon–Fano coding, Huffman Coding, LZ Coding – Channel capacity – Shannon-Hartley law – Shannon’s limit – Error control codes – Cyclic codes, Syndrome calculation – Convolution Coding, Sequential and Viterbi decoding

UNIT V SPREAD SPECTRUM AND MULTIPLE ACCESS 9

PN sequences – properties – m-sequence – DSSS – Processing gain, Jamming – FHSS – Synchronisation and tracking – Multiple Access – FDMA, TDMA, CDMA,

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
- Apply analog and digital communication techniques.
- Use data and pulse communication techniques.
- Analyze Source and Error control coding.

TEXT BOOKS:

1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007
2. S. Haykin "Digital Communications" John Wiley 2005

REFERENCES:

1. B.P.Lathi, "Modern Digital and Analog Communication Systems", 3rd edition, Oxford University Press, 2007
2. H P Hsu, Schaum Outline Series – "Analog and Digital Communications" TMH 2006
3. B.Sklar, Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007.

EI8461 DEVICES AND MACHINES LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES

1. To facilitate the students to study the characteristics of various semiconductor devices.
2. To provide practical knowledge on the analysis of regulators, amplifiers and oscillators.
3. To obtain the no load and load characteristics of D.C machines.
4. To obtain the speed characteristics of D.C motor.
5. To find out regulation characteristics of Transformer.

LIST OF EXPERIMENTS FOR DEVICES LAB

1. Simulation and experimental Characteristion of Semiconductor diode and Zener diode.
2. Simulation and experimental Characteristion of a NPN Transistor under common emitter configurations.
3. Simulation and experimental Characterisation of FET and JFET(Draw the equivalent circuit)
4. Simulation and experimental Characterisation of UJT and generation of saw tooth waveforms
5. Simulation and experimental Characterisation of RC and LC phase shift oscillators.
6. Simulation and experimental Characterisation of Monostable and Astable multivibrators.
7. Simulation of passive filters.
8. Simulation of Single Phase half-wave and full wave rectifiers with inductive and capacitive filters.
9. Characteristics of SCR and application as a controlled rectifier.

Minimum of five experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

LIST OF EXPERIMENTS FOR MACHINES LAB

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator.
3. Load test on D.C. shunt motor.
4. Speed control of D.C. shunt motor.
5. Open circuit and short circuit tests on single phase transformer (Determination of equivalent circuit parameters).
6. Load test on single phase induction motor.

Minimum of five experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1 Gain knowledge on the proper usage of various electronic equipment and simulation tools for design and analysis of electronic circuits.
2 Get hands-on experience in studying the characteristics of semiconductor devices.
3 Ability to analyze various electronic circuits such as voltage regulators, transistor amplifiers and oscillators.
4 Ability to make use of basic concepts to obtain the no load and load characteristics of D.C machines.
5 Analyze and draw conclusion from the characteristics obtained by conducting experiments on machines.
6 Ability to carry out the Experiments in batches to motivate the Team work.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
FOR DEVICES LAB:

S.No	Name of the Equipment / Components
1.	Circuit Simulation Software (5 Users) (Pspice / Matlab /other Equivalent software Package) with PC.
2.	Sufficient number of power supply, Galvanometer, Bread board, Multimeter, resistors, Decade Capacitance box, Decade resistance box, Decade Inductance box, CRO.
3.	Semiconductor devices like Diode, Zener Diode, NPN Transistors, JFET, and UJT.

FOR MACHINES LAB:

S.No	Name of the Equipment / Components	Quantity Required
1.	DC Shunt Motor with Loading Arrangement	3
2.	Single Phase Transformer	3

3.	Single Phase Induction Motor with Loading Arrangement	1
4.	Single Phase Auto Transformer	3
5.	Single Phase Resistive Loading Bank	2
6.	Sufficient number of Ammeters, Voltmeters, (or multimeters), switches, tachometers, Wattmeters.	2

EE8461 LINEAR AND DIGITAL INTEGRATED CIRCUITS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

- To learn design, testing and characterizing of circuit behavior with digital and analog ICs.

LIST OF EXPERIMENTS

1. Implementation of Boolean Functions, Adder and Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
3. Parity generator and parity checking
4. Encoders and Decoders
5. Counters: Design and implementation of 3-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitability IC's.
7. Study of multiplexer and de multiplexer
8. Timer IC application: Study of NE/SE 555 timer in Astability, Monostability operation.
9. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
10. Voltage to frequency characteristics of NE/ SE 566 IC.
11. Variability Voltage Regulator using IC LM317.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, the student should have the :

- Ability to understand and implement Boolean Functions.
- Ability to understand the importance of code conversion
- Ability to Design and implement 4-bit shift registers
- Ability to acquire knowledge on Application of Op-Amp
- Ability to Design and implement counters using specific counter IC.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS: (3 per Batch)

S.No	Name of the equipments / Components	Quantity Required	Remarks
1	Dual ,(0-30V) variability Power Supply	10	-
2	CRO	9	30MHz
3	Digital Multimeter	10	Digital
4	Function Generator	8	1 MHz
5	IC Tester (Analog)	2	
6	Bread board	10	
7	Computer (PSPICE installed)	1	
	Consumabilitys (sufficient quantity)		
1	IC 741/ IC NE555/566/565		
2	Digital IC types		
3	LED		
4	LM317		
5	LM723		
6	ICSG3524 / SG3525		
7	Transistor – 2N3391		
8	Diodes, IN4001,BY126		
9	Zener diodes		
10	Potentiometer		
11	Step-down transformer 230V/12-0-12V		
12	Capacitor		
13	Resistors 1/4 Watt Assorted		
14	Single Strand Wire		

EI8551 **ANALYTICAL INSTRUMENTS** **LT P C**
3 0 0 3

COURSE OBJECTIVES

- To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
- To impart fundamental knowledge on gas chromatography and liquid chromatography.
- To integrate a fundamental understanding of the underlining principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments.

- To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
- To understand the working principle, types and applications of NMR and Mass spectroscopy.

UNIT I SPECTROPHOTOMETRY 9

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

UNIT II CHROMATOGRAPHY 9

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

UNIT III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS 9

Gas analyzers – Oxygen, NO_2 and H_2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases.

Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - 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.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1 . Ability to understand the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.
2. Ability to assess and suggest a suitable analytical method for a specific purpose, and evaluate sensitivity, important sources of interferences and errors, and also suggest alternative analytical methods for quality assurance.
3. Ability to critically evaluate the strengths and limitations of the various instrumental methods.
4. Ability to develop critical thinking for interpreting analytical data.
5. Ability to understand the working principle, types and applications of NMR and Mass spectroscopy

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. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2006.
3. Robert E. Sherman., "Analytical Instrumentation", Instruments Society of America, 1996.

REFERENCES:

1. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw-Hill publishing Co. Ltd.,2nd Edition 2007.
2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", McGraw-Hill, 5th Edition reprint 1985. (Digitized in 2007).
3. Liptak, B.G., "Process Measurement and Analysis", CRC Press, 5th Edition, 2015.
4. NPTEL lecture notes on, "Modern Instrumental methods of Analysis" by Dr.J.R. Mudakavi, IISC, Bangalore.

EI8552 INDUSTRIAL INSTRUMENTATION - II L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce variable head type flow meters
- To introduce quantity meters, air flow meters and mass flow meters
- To educate on electrical type flow meters
- To educate on the level measurement techniques
- To educate on Viscosity, Humidity and Moisture content

UNIT I VARIABLE HEAD TYPE FLOWMETERS 9

Expression for flow rate through restriction(compressible and incompressible flow) -Orifice plate**:** different types of orifice plates – Cd variation – pressure tappings – Venturi tube – Flow nozzle – Dall tube – Pitot tube**:** combined pitot tube, averaging 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: Rotameter –theory, characteristics, installation and applications – Mass flow meter :– Angular momentum – Thermal, 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 gauges - Displacer type – D/P methods -Bubbler system-Load cell – Electrical types – Conductivity sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement :– Differential pressure method and Hydrastep method - Solid level measurement.

UNIT V TRANSMITTERS 9

Pneumatic transmitter: Operation - Electronic transmitter: Study of 2 wire and 4 wire transmitters – Operation of Electronics and Smart transmitters – Principle of operation of flow, level, temperature and pressure transmitters – Installation and Calibration of smart and conventional transmitters.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

At the end of the course, the student will have the:

1. Ability to understand the construction, installation and working of different variable head type flow meters.
2. Able to 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.
3. Ability to gain knowledge about the construction, working and calibration of different type of transmitters.
4. Ability to choose appropriate flow meters or level sensor for an application.

TEXT BOOKS:

1. Doebellin, E.O. and Manik D.N., “Measurement systems Application and Design”, 5th 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.

REFERENCES:

1. Liptak, B.G., Instrumentation Engineers Handbook (Measurement), CRC Press, 2005.

2. Singh,S.K., Industrial Instrumentation and Control, Tata McGrawHill Education Pvt. Ltd., New Delhi, 2009.

3. Jain, R.K., Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.

4. Jayashankar, V., “Lecture Notes on Industrial Instrumentation”, NPTEL, E-Learning Course, IIT Madras.

EI8553 PROCESS CONTROL LT P C
2 2 0 3

COURSE OBJECTIVES

- To introduce technical terms and nomenclature associated with Process control domain.
- To familiarize the students with characteristics, selection, sizing of control valves.
- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID tuning methods.
- To elaborate different types of control schemes such as cascade control, feed-

forward control and Model Based control schemes.

UNIT I PROCESS MODELLING AND DYNAMICS 6+6

Need for process control – Mathematical Modeling of Processes**:** Level, Flow, Pressure and Thermal processes – Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR – Linearization of nonlinear systems.

UNIT II FINAL CONTROL ELEMENTS 6+6

Actuators: Pneumatic and electric actuators – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves – Cavitation and flashing – Control Valve selection

UNIT III CONTROL ACTIONS 6+6

Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers – P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation Issues**:** Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action.

UNIT IV PID CONTROLLER TUNING 6+6

PID Controller Design Specifications**:** Criteria based on Time Response and Criteria based Frequency Response - PID Controller Tuning**:** Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, optimization methods, Auto tuning – Cascade control – Feed-forward control

UNIT V MODEL BASED CONTROL SCHEMES 6+6

Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller –- Three-element Boiler drum level control - Introduction to Multi-loop Control Schemes – Control Schemes for CSTR, and Heat Exchanger - P&ID diagram.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

- Ability to understand technical terms and nomenclature associated with Process control domain.
- Ability to build models using first principles approach as well as analyze models.
- Ability to Design, tune and implement PID Controllers to achieve desired
- performance for various processes
- Ability to Analyze Systems and design & implement control Schemes for various Processes.
- Ability to Identify, formulate and solve problems in the Process Control Domain.

TEXT BOOKS:

1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John and Sons, 2nd Edition, 2003.

2. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004.

3. Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hall of India, 2005.

REFERENCES:

1. Coughanowr, D.R., “Process Systems Analysis and Control”, McGraw - Hill International Edition,2004.
2. Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson, 2006.
3. Considine, D.M., Process Instruments and Controls Handbook, Second Edition, McGraw, 1999.
4. Bela.G.Liptak., “Process Control and Optimization”., Instrument Engineers’ Handbook., volume 2, CRC press and ISA, 2005.
5. Ramesh C. Panda., T.Thyagarajan., “An Introduction to Process Modelling Identification and Control for Engineers” Narosa Publishing house Pvt. Ltd, 2017.

EE8551	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

- Architecture of µP8085 & µC 8051
- Addressing modes & instruction set of 8085 & 8051.
- Need & use of Interrupt structure 8085 & 8051.
- Simple applications development with programming 8085 & 8051

UNIT I 8085 PROCESSOR 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up tability - Subroutine instructions - stack.

UNIT III 8051 MICRO CONTROLLER 9

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts- Data Transfer, Manipulation, Control Algorithms& I/O instructions, Comparison to Programming concepts with 8085.

UNIT IV PERIPHERAL INTERFACING 9

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters &Interfacing with 8085& 8051.

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Simple programming exercises- key board and display interface –Control of servo motor-stepper motor control- Application to automation systems.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to acquire knowledge in Addressing modes & instruction set of 8085 & 8051.
- Ability to need & use of Interrupt structure 8085 & 8051.
- Ability to understand the importance of Interfacing
- Ability to explain the architecture of Microprocessor and Microcontroller.
- Ability to write the assembly language programme.
- Ability to develop the Microprocessor and Microcontroller based applications.

TEXT BOOKS:

1. Sunil Mathur &Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.
2. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013.
3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.

REFERENCES

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
2. B.RAM," Computer Fundamentals Architecture and Organization" New age International Private Limited, Fifth edition, 2017.
3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
4. Ajay V.Deshmukh, 'Microcontroller Theory &Applications', McGraw Hill Edu,2016
5. Douglas V.Hall, 'Microprocessor and Interfacing', McGraw Hill Edu,2016.

EE8591	DIGITAL SIGNAL PROCESSING	L	T	P	C
		2	2	0	3

OBJECTIVES: To impart knowledge about the following topics:

- Signals and systems & their mathematical representation.
- Discrete time systems.
- Transformation techniques & their computation.
- Filters and their design for digital implementation.
- Programmability digital signal processor & quantization effects.

UNIT I INTRODUCTION 6+6

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II DISCRETE TIME SYSTEM ANALYSIS 6+6

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems - Stability analysis, frequency response – Convolution – Discrete Time Fourier transform , magnitude and phase representation.

UNIT III DISCRETE FOURIER TRANSFORM & COMPUTATION 6+6

Discrete Fourier Transform- properties, magnitude and phase representation - Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure.

UNIT IV DESIGN OF DIGITAL FILTERS 6+6

FIR & IIR filter realization – Parallel & cascade forms. FIR design: Windowing Techniques – Need and choice of windows – Linear phase characteristics. Analog filter design – Butterworth and Chebyshev approximations; IIR Filters, digital design using impulse invariant and bilinear transformation Warping, pre warping.

UNIT V DIGITAL SIGNAL PROCESSORS 6+6

Introduction – Architecture – Features – Addressing Formats – Functional modes - Introduction to Commercial DS Processors.

TOTAL : 60 PERIODS

OUTCOMES:

1. Ability to understand the importance of Fourier transform, digital filters and DS Processors.
2. Ability to acquire knowledge on Signals and systems & their mathematical representation.
3. Ability to understand and analyze the discrete time systems.
4. Ability to analyze the transformation techniques & their computation.
5. Ability to understand the types of filters and their design for digital implementation.
6. Ability to acquire knowledge on programmability digital signal processor & quantization effects.

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2003.

2. S.K. Mitra, 'Digital Signal Processing – A Computer Based Approach', McGraw Hill Edu, 2013.

3. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing",Wiley,2013

REFERENCES

1. Poorna Chandra S, Sasikala. B ,Digital Signal Processing, Vijay Nicole/TMH,2013.

2. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", Cengage Learning,2014.

3. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010 3. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with Mat Lab', CRC Press, 2009.

4. SenM.kuo, woonseng…s.gan, "Digital Signal Processors, Architecture, Implementations & Applications, Pearson,2013

5. DimitrisG.Manolakis, Vinay K. Ingle, applied Digital Signal Processing,Cambridge,2012

EI8561	INDUSTRIAL INSTRUMENTATION LABORATORY	L T P C
		0 0 4 2

COURSE OBJECTIVES

1. To impart an adequate knowledge and expertise to handle equipment generally available in an industry
2. To make the students aware about calibration of meters, sensors and transmitters.
3. To make the students conscious about the working and operation of different types of analytical Instruments.
4. To identify, formulate, and analyze problems regarding sensors and transmitter

LIST OF EXPERIMENTS

1. Measurement of speed, torque and vibration
2. Calibration of ammeter, voltmeter and wattmeter using multifunction calibrator
3. Calibration of pressure gauge using dead weight tester.
4. Measurement of level using d/p transmitter and fibre optics system.
5. Measurement of flow using
    a. Discharge coefficient of orifice plate
    b. Calibration of Rotameter.
6. Design and Testing of Electromagnetic Flow meters.
7. Measurement of temperature using IR thermometer and IC sensor
8. Measurement of Absorbance and Transmittance of Test solutions using UV-Spectrometer.
9. Measurement of Conductivity, Moisture and Viscosity of test solutions.
10. Standardization and measurement of pH values of different solutions
11. Measurement and analysis of ECG and pulse rate.

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL: 60 PERIODS

COURSE OUTCOMES (COs)

1. Ability to experimentally measure industrial process parameters such as flow, level, temperature, pressure and viscosity.
2. Ability to measure and analyze pH, conductivity, UV absorbance and transmittance.
3. Ability to measure and analyze physiological parameters such as BP, ECG and pulse rate.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Orifice plate	1
2.	Dead weight tester with pressure gauge	1
3.	Torque trainer	1
4.	Saybolt Viscometer	1
5.	Vacuum gauge	1
6.	DP transmitter	1
7.	UV – Visible spectrophotometer	1
9.	pH meter	1
10.	Conductivity meter	1
11.	ECG trainer	1
12.	Pulse rate trainer	1
13.	tacho meter	

EE8681 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY

L	T	P	C
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OBJECTIVES:

- To provide training on programming of microprocessors and microcontrollers and understand the interface requirements.
- To simulate various microprocessors and microcontrollers using KEIL or Equivalent simulator.

LIST OF EXPERIMENTS

1. Simple arithmetic operations: addition / subtraction / multiplication / division.
2. Programming with control instructions:
   - (i) Ascending / Descending order, Maximum / Minimum of numbers.
   - (ii) Programs using Rotate instructions.
   - (iii) Hex / ASCII / BCD code conversions.
3. Interface Experiments: with 8085
   - (i) A/D Interfacing. & D/A Interfacing.
4. Traffic light controller.
5. I/O Port / Serial communication
6. Programming Practices with Simulators/Emulators/open source
7. Read a key ,interface display
8. Demonstration of basic instructions with 8051 Micro controller execution, including:
   - (i) Conditional jumps & looping
   - (ii) Calling subroutines.
9. Programming I/O Port and timer of 8051
   - (i) study on interface with A/D & D/A
   - (ii) Study on interface with DC & AC motors
10. Application hardware development using embedded processors.

TOTAL: 60 PERIODS

OUTCOMES:

- Ability to understand and apply computing platform and software for engineering problems.
- Ability to programming logics for code conversion.
- Ability to acquire knowledge on A/D and D/A.
- Ability to understand basics of serial communication.
- Ability to understand and impart knowledge in DC and AC motor interfacing.
- Ability to understand basics of software simulators.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No.	Description of Equipment	Quantity required
1.	8085 Microprocessor Trainer with Power Supply	15
2.	8051 Micro Controller Trainer Kit with power supply	15
3.	8255 Interface boards	5
4.	8251 Interface boards	5
5.	8259 Interface boards	5

6.	8279 Keyboard / Display Interface boards	5
7.	8254 timer/ counters	5
8.	ADC and DAC cards	5
9.	AC & DC motor with Controller s	5
10.	Traffic Light Control Systems	5

EI8651 LOGIC AND DISTRIBUTED CONTROL SYSTEM LT P C
3 0 0 3

COURSE OBJECTIVES

- To give an overview of the automation technologies such as PLCs, SCADA and DCS used in industries.
- To provide a fundamental understanding of the different languages used for PLC Programming
- To provide insight into some of the advanced principles those are evolving for present and future automation.

UNIT I PLC & SCADA 9

PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Comparative study of Industrial PLCs.
SCADA: Remote terminal units- Master station - Communication architectures.

UNIT II BASICS OF PLC PROGRAMMING(LADDER) 9

Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/Counter instructions – Program control instructions – Data manipulation and math instructions – Programming Examples.

UNIT III PLC PROGRAMMING (OTHER LANGUAGES) 9

Functional block programming - Sequential function chart – Instruction list – Structured text programming – PLC controlled sequential Process Examples.

UNIT IV DISTRIBUTED CONTROL SYSTEM 9

DCS: Evolution & types – Hardware architecture – Field control station – Interfacing of conventional and smart field devices (HART and FF enabled) with DCS Controller – Communication modules – Operator and Engineering Human interface stations – Study of any one DCS available in market.

UNIT V ADVANCED TOPICS IN AUTOMATION 9

Introduction to Networked Control systems – Plant wide control – Internet of things – Cloud based Automation – OLE for Process Control – Safety PLC – Case studies: PLC - SCADA - DCS.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

- Ability to understand all the important components such as PLC, SCADA, DCS,I/O modules and field devices of an industrial automation system.
- Ability to develop PLC program in different languages for industrial sequential applications.
- Able to select and use most appropriate automation technologies for a given application.

- Ability to gain knowledge on the recent developments in industrial automation.

TEXT BOOKS:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 1986
3. D. Popovic and V.P.Bhatkar,' Distributed computer control for industrial Automation' Marcel Dekker, Inc., Newyork ,1990.

REFERENCES:

1. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems", Newnes, 1st Edition, 2004.
2. Hughes, T.A., "Programmable Logic Controllers: Resources for Measurements and Control Series", 3rd Edition, ISA Press, 2004.
3. McMillan, G.K., "Process/Industrial Instrument and Controls Handbook", 5thEdition, McGraw- Hill handbook, New York, 1999.
4. NPTEL Notes on, "Programmable Logic Control System" by Department of Electrical Engg., IIT Kharagpur.

EI8691 COMPUTER CONTROL OF PROCESSES LT P C
3 0 0 3

COURSE OBJECTIVES

- **To represent the linear time invariant System in discrete State Space form.**
- To analyze the controllability, observability and stability of a Discrete time System.
- To estimate model parameters from input/output measurements
- To Design Digital Controllers
- To Design Multi-loop and Multivariable Controllers for multivariable system

UNIT I DISCRETE STATE-VARIABLE TECHNIQUE 9

State equation of discrete data system with sample and hold – 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.

UNIT II SYSTEM IDENTIFICATION 9

Identification of Non Parametric Input-Output Models:-Transient analysis–Frequency analysis– Correlation analysis– Spectral analysis – Identification of Parametric Input-Output Models:- Least Squares Method – Recursive Least Square Method.

UNIT III DIGITAL CONTROLLER DESIGN 9

Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller – Dead-beat controller and Dahlin's controller – IMC - Smith Predictor.

UNIT IV MULTI-LOOP REGULATORY CONTROL 9

Multi-loop Control - Introduction – Process Interaction – Pairing of Inputs and Outputs -The Relative Gain Array (RGA) – Properties and Application of RGA - Multi-loop PID Controller – Biggest Log Modulus Tuning Method – De-coupler.

UNIT V MULTIVARIABLE REGULATORY CONTROL 9

Introduction to Multivariable control –Multivariable PID Controller – Multivariable Dynamic Matrix Controller – Fuzzy Logic Controller – Case Studies:- Distillation Column, CSTR and Four-tank system.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to analyze the discrete time systems
2. Ability to build models from input-output data
3. Ability to design a digital controller
4. Ability to design multi-loop controller and multivariable controller for multi-variable systems.

TEXT BOOKS:

1. Stephanopoulos, G., "Chemical Process Control -An Introduction to Theory and Practice", Prentice Hall of India, 2005.

2. Sigurd Skogestad, Ian Postlethwaite, "Multivariable Feedback Control: Analysis and Design", John Wiley and Sons, 2005.

REFERENCES:

1. Gopal, M., "Digital Control and State Variable Methods", Tata Mc Graw Hill, 2003.
2. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, "Process Dynamics and Control", Wiley John and Sons, 3rd Edition, 2010.
3. P. Albertos and A. Sala, "Multivariable Control Systems An Engineering Approach", Springer Verlag, 2006.
4. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2008.
5. Thomas E. Marlin, Process Control – Designing Processes and Control systems for Dynamic Performance, Mc-Graw-Hill,2000.

CS8391 DATA STRUCTURES L T P C
3 0 0 3

OBJECTIVES:

- To understand the concepts of ADTs
- To Learn linear data structures – lists, stacks, and queues
- To understand sorting, searching and hashing algorithms
- To apply Tree and Graph structures

UNIT I LINEAR DATA STRUCTURES – LIST 9

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists- circularly linked lists- doubly-linked lists – applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT II LINEAR DATA STRUCTURES – STACKS, QUEUES 9

Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue - deQueue – applications of queues.

UNIT III NON LINEAR DATA STRUCTURES – TREES 9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree **-** Heap – Applications of heap.

UNIT IV NON LINEAR DATA STRUCTURES - GRAPHS 9

Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

UNIT V SEARCHING, SORTING AND HASHING TECHNIQUES 9

Searching- Linear Search - Binary Search. Sorting - Bubble sort - Selection sort - Insertion sort - Shell sort – Radix sort. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Implement abstract data types for linear data structures.
- Apply the different linear and non-linear data structures to problem solutions.
- Critically analyze the various sorting algorithms.

TEXT BOOKS:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson Education,1997.
2. Reema Thareja, “Data Structures Using C”, Second Edition , Oxford University Press, 2011

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L.Rivest, Clifford Stein, “Introduction to Algorithms", Second Edition, Mcgraw Hill, 2002.
2. Aho, Hopcroft and Ullman, “Data Structures and Algorithms”, Pearson Education,1983.

3. Stephen G. Kochan, “Programming in C”, 3rd edition, Pearson Education.
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, “Fundamentals of Data Structures in C”, Second Edition, University Press, 2008

EI8692 ELECTRONIC INSTRUMENTATION LT P C
3 0 0 3

COURSE OBJECTIVES

- To introduce different types of electronic voltmeters and their applications.
- To provide knowledge on various types of cathode ray oscilloscopes, their applications and different types of signal analyzers.
- To introduce different types of waveform generators and analyzers and their applications.
- To educate on virtual instrumentation, its applications, programming and DAQ cards and modules.
- To give exposure to telemetry, modulation techniques and multiplexing.

UNIT I ELECTRONIC INSTRUMENTS 9

Electronic Voltmeter and their advantages – Types, Differential amplifier, source follower, rectifier – Truerms reading voltmeter – Electronic multimeter and ohmmeter – Current measurement – Power measurement - Microprocessor based DMM with auto ranging and self diagnostic features.

UNIT II CATHODE RAY OSCILLOSCOPE & SIGNAL ANALYZERS 9

General purpose cathode ray oscilloscope – Dual trace, dual beam and sampling oscilloscopes– Analog and digital storage oscilloscope - frequency selective and heterodyne wave analyzer – Harmonic distortion analyzer – Spectrum analyzer.

UNIT III WAVEFORM GENERATORS 9

Wien’s bridge and phase shift oscillators – Hartley and crystal oscillators – Square wave and pulse generators – Triangular wave-shape generator - Signal and function generators – Q meter – Electronic Counters.

UNIT IV VIRTUAL INSTRUMENTATION 9

Virtual instrumentation (VI) – Definition, flexibility – Block diagram and architecture of virtual instruments – Virtual instruments versus traditional instruments – Software in virtual instrumentation - VI programming techniques – DAQ cards for VI applications – DAQ modules with serial communication.

UNIT V TELEMETRY 9

General telemetry system – voltage, current and position telemetry systems – Radio frequency telemetry – Frequency modulation, pulse-amplitude modulation and pulse-code modulation telemetry – Frequency and time multiplexing.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

- Ability to understand and analyze Instrumentation systems and their applications to various industries.

TEXT BOOKS:

1. A.D. Helfrick and W.D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Prentice Hall India Private Ltd., New Delhi, 2010.

2. David A Bell, " Electronic Instrumentation and Measurements", Ox for University Press, 2013.

3. Jerome J., Virtual Instrumentation using Lab VIEW, Prentice Hall India Private Ltd., New Delhi,2010.

REFERENCES:

1. H.S. Kalsi, Electronic Instrumentation, Tata McGraw-Hill, New Delhi, 2010.

2. J.J. Carr, Elements of Electronic Instrumentation and Measurement, Pearson Education India, New Delhi, 2011.

3. M.M.S. Anand, Electronics Instruments and Instrumentation Technology, Prentice Hall India, New Delhi, 2009.

4. Sanjay Gupta, Virtual Instrumentation using Lab view, Tata McGraw-Hill Education, 2010.

CS8381 DATA STRUCTURES LABORATORY L T P C
0 0 4 2

OBJECTIVES

- To implement linear and non-linear data structures
- To understand the different operations of search trees
- To implement graph traversal algorithms
- To get familiarized to sorting and searching algorithms

1. Array implementation of Stack and Queue ADTs
2. Array implementation of List ADT
3. Linked list implementation of List, Stack and Queue ADTs
4. Applications of List, Stack and Queue ADTs
5. Implementation of Binary Trees and operations of Binary Trees
6. Implementation of Binary Search Trees
7. Implementation of AVL Trees
8. Implementation of Heaps using Priority Queues.
9. Graph representation and Traversal algorithms
10. Applications of Graphs
11. Implementation of searching and sorting algorithms
12. Hashing – any two collision techniques

TOTAL : 60 PERIODS

OUTCOMES

At the end of the course, the students will be able to:

- Write functions to implement linear and non-linear data structure operations
- Suggest appropriate linear / non-linear data structure operations for solving a given problem
- Appropriately use the linear / non-linear data structure operations for a given problem
- Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval

EI8661 PROCESS CONTROL LABORATORY L T P C
0 0 4 2

OBJECTIVES:

1. To experimentally verify the process control concepts on the selected process control loops.
2. To impart theoretical and practical skills in process identification and PID controller tuning
3. To make the students aware of basic and advanced control schemes

LIST OF EXPERIMENTS:

Simulation Based Experiments

1. Simulation of lumped /distributed parameter system
2. Mathematical model of a typical industrial process using nonparametric identification methods
3. Tuning of PID Controller for mathematically described processes
4. PID Enhancements (Cascade and Feed-forward Control Schemes)
5. Design and Implementation of Multi-loop PID Controller on the simulated model of a typical industrial process.
6. Study of AC and DC drives.

Hardware based experiments

1. Characteristics of Pneumatically Actuated Control Valve (with and without Positioner).
2. Study and control of flow process using Compact Flow Control Unit.
3. Control of Level and Pressure using Process Control Training Plant.
4. Design and implementation of ON/OFF Controller for the Temperature Process.
5. Design and implementation of Interacting and non-interacting system
6. Design and implementation of adaptive or model predictive control schemes

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

OUTCOMES:

1. Ability to understand and analyze process control engineering problems.
2. Be able to build dynamic models using input – output data of a process
3. Ability to working with real time control loops(flow/level/temperature/pressure)
4. Get exposed to simulation tools such as MATLAB/LABVIEW/ASPEN
5. Ability to learn and implement simple adaptive and model based control schemes

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Flow process station with all accessories
2. Analog / Digital PID controller
3. Control valve setup (with position for varying ΔP across the valve)
4. Flow meter
5. Level process station with all accessories

6. Temperature process station with all accessories
7. Pressure process station with all accessories
7. Personal computer-15 nos
8. MATLAB software
9. Two tank system with following accessories.

HS8581	PROFESSIONAL COMMUNICATION	L T P C 0 0 2 1

OBJECTIVES: The course aims to:

- Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates
- Develop their confidence and help them attend interviews successfully.

UNIT I

Introduction to Soft Skills-- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Time Management—General awareness of Current Affairs

UNIT II

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice— presenting the visuals effectively – 5 minute presentations

UNIT III

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- activities to improve GD skills

UNIT IV

Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview – FAQs related to job interviews

UNIT V

Recognizing differences between groups and teams- managing time-managing stress- networking professionally- respecting social protocols-understanding career management-developing a long-term career plan-making career changes.

TOTAL : 30 PERIODS

OUTCOMES: At the end of the course Learners will be able to:

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

Recommended Software

1. **Globearena**

2. Win English

REFERENCES:

1. Butterfield, Jeff **Soft Skills for Everyone.** Cengage Learning: New Delhi, 2015
2. **Interact** English Lab Manual for Undergraduate Students,. OrientBalckSwan: Hyderabad, 2016.
3. E. Suresh Kumar et al. **Communication for Professional Success.** Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. **Professional Communication**. Oxford University Press: Oxford, 2014
5. S. Hariharanetal. **Soft Skills**. MJP Publishers: Chennai, 2010.

EI8751 INDUSTRIAL DATA NETWORKS LT P C
3 0 0 3

OBJECTIVES:

- To educate on the basic concepts of data networks
- To introduce the basics of internetworking and serial communications
- To provide details on HART and Field buses
- To educate on MODBUS, PROFIBUS and other communication protocol
- To introduce industrial Ethernet and wireless communication

UNIT I DATA NETWORK FUNDAMENTALS 9

Networks hierarchy and switching – Open System Interconnection model of ISO - Data link control protocol - Media access protocol - Command / response - Token passing -CSMA/CD, TCP/IP

UNIT II INTERNET WORKING and RS 232, RS485 9

Bridges - Routers - Gateways - Standard ETHERNET and ARCNET configuration special requirement for networks used for control - RS 232, RS 485 configuration Actuator Sensor (AS) – interface, Devicenet

UNIT III HART AND FIELD BUS 9

Introduction - Evolution of signal standard - HART communication protocol - HART networks - HART commands - HART applications - Fieldbus - Introduction - General Fieldbus architecture - Basic requirements of Fieldbus standard - Fieldbus topology - Interoperability - Interchangeability - Introduction to OLE for process control (OPC).

UNIT IV MODBUS AND PROFIBUS PA/DP/FMS AND FF 9

MODBUS protocol structure - function codes – troubleshooting Profibus, Introduction, Profibus protocol stack, Profibus communication model - communication objects - system operation - troubleshooting - review of foundation fieldbus - Data Highway

UNIT V INDUSTRIAL ETHERNET AND WIRELESS COMMUNICATION 9

Industrial Ethernet, Introduction, 10 Mbps Ethernet, 100 Mbps Ethernet - Radio and wireless

communication, Introduction, components of radio link - radio spectrum and frequency allocation - radio MODEMs-Introduction to wireless HART and ISA100.

TOTAL : 45 PERIODS

OUTCOMES: Students will have the

- Ability to define basic concepts of data communication and its importance.
- Ability to explain the various internetworking devices involved in industrial networks
- Ability to explain the various serial communication used in process industries.
- Ability to illustrate, compare & explain the working of HART and Field bus used in process digital communication.
- Ability to summarize the operation of MODBUS, PROFIBUS protocol & its applications.
- Ability to explain and adopt the different Industrial Ethernet protocol and usage of wireless communication in process applications.

TEXT BOOKS:

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition, 2004
2. William Buchanan, Computer Buses, CRC Press, 2000.
3. BehrouzForouzan ,Data Communications & Networking ,3RD edition, Tata McGraw hill,2006.

REFERENCES

1. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
2. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001.
3. William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005.

TOTAL :45. PERIODS

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EE8691	**EMBEDDED SYSTEMS**	**3**	**0**	**0**	**3**

OBJECTIVES:

To impart knowledge on the following Topics

- Building Blocks of Embedded System
- Various Embedded Development Strategies
- Bus Communication in processors, Input/output interfacing.
- Various processor scheduling algorithms.
- Basics of Real time operating system and example tutorials to discuss on one real time operating system tool.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems –Structural units in Embedded processor , selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Real Time Clock, In circuit emulator, Target Hardware Debugging.

UNIT II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols RS232 standard – RS422 – RS 485 - CAN Bus -Serial Peripheral Interface (SPI) – Inter Integrated Circuits (I^2C) –need for device drivers.

UNIT III EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT 9

Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance.

UNIT V EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT 9

Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze Embedded systems.
- Ability to suggest an embedded system for a given application.
- Ability to operate various Embedded Development Strategies
- Ability to study about the bus Communication in processors.
- Ability to acquire knowledge on various processor scheduling algorithms.
- Ability to understand basics of Real time operating system.

TEXT BOOKS:

1. Peckol, “Embedded system Design”, John Wiley & Sons,2010
2. Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013
3. Shibu. K.V, “Introduction to Embedded Systems”, 2e, Mc graw Hill, 2017.

REFERENCES

1. Raj Kamal, ‘Embedded System-Architecture, Programming, Design’, Mc Graw Hill, 2013.
2. C.R.Sarma, “Embedded Systems Engineering”, University Press (India) Pvt. Ltd, 2013.
3. Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.
4. Han-Way Huang, “Embedded system Design Using C8051”, Cengage Learning, 2009.
5. Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.

EC8093 **DIGITAL IMAGE PROCESSING** **L T P C**
3 0 0 3

OBJECTIVES:

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT 9

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION 9

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT IV IMAGE SEGMENTATION 9

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION 9

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

TOTAL :45 PERIODS

OUTCOMES:

At the end of the course, the students should be able to:

- Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Understand the restoration concepts and filtering techniques.
- Learn the basics of segmentation, features extraction, compression and recognition methods for color models.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition, 2010.
2. Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

REFERENCES

1. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.
3. D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002
5. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999

EI8761 INDUSTRIAL AUTOMATION LABORATORY LT P C
0 0 4 2

OBJECTIVES:

To impart practical skills in

1. Programming of PLC and DCS.
2. Sensor data acquisition, data processing and visualization
3. Interfacing the various field devices with PLC

LIST OF EXPERIMENTS:

1. Study of PLC field device interface modules (AI,AO,DI,DO modules)
2. Programming Logic Gates Function in PLC
3. Implementing Mathematical Operations in PLC
4. Programming Jump-to-subroutine & return operations in PLC
5. PLC Exercises:- 1. Traffic Light Control and Filling/Draining Control Operation
6. PLC Exercise: 1. Reversal of DC Motor Direction 2. ON/OFF Controller for Thermal Process
7. PC based control of Level Process

8. On-line Monitoring and Control of a Pilot plant using DCS
9. PLC based Control of Flow Process
10. Study of Foundation Fieldbus /IOT/Wireless HART Enabled Transmitter

TOTAL: 60 PERIODS

OUTCOMES:

1. Ability to understand and Programming of PLC, SCADA and DCS

2. Ability to working with industrial automation system

3. Be able to design and implement control schemes in PLC & DCS

4. Ability to interface field devices with PLC & DCS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Programmable Logic controller 5 Nos.
2. Programmable Logic controller Software 10 User License
3. DAQ card 2 Nos.
4. Filling /Draining System 1 No.
5. Traffic Light Controller 2 Nos
6. DC Motor 5 Nos
7. Personal computer- 10 Nos
8. DCS along with Interface modules 1 set
9. Thermal Process, Level Process & Flow Process stations – 1 set each
10. Smart Transmitter - 1 No.

EI8762 INSTRUMENTATION SYSTEM DESIGN LABORATORY LT P C
0 0 4 2

OBJECTIVES:

1. To obtain adequate knowledge in design of various signal conditioning circuits and instrumentation systems.
2. To impart design knowledge of controller, control valve and transmitter.
3. To acquire the knowledge of piping diagram of industrial standard
4. To make the students aware of industry project, planning and scheduling.

LIST OF EXPERIMENTS:

1. Design of Instrumentation amplifier.
2. Design of active filters – LPF, HPF and BPF
3. Design of regulated power supply and design of V/I and I/V converters.
4. Design of linearizing circuits and cold–junction compensation circuit for thermocouples.

5. Design of signal conditioning circuit for strain gauge and RTD.
6. Design of orifice plate and rotameter.
7. Design of Control valve (sizing and flow-lift characteristics)
8. Design of PID controller (using operational amplifier and microprocessor)
9. Design of a multi-channel data acquisition system
10. Design of multi range DP transmitter
11. Piping and Instrumentation Diagram – case study.
12. Preparation of documentation of instrumentation project and project scheduling for the above case study. (Process flow sheet, instrument index sheet and instrument specifications sheet, job scheduling, installation procedures and safety regulations).

Minimum of ten experiments to be offered from the list. Additional one or two experiments can be framed beyond the list or curriculum

TOTAL: 60 PERIODS

OUTCOMES:

1. Ability to understand design of signal conditioning circuits and instrumentation systems.
2. Ability to design controller, control valve and transmitter.
3. Be able to design and draw the piping diagram for industrial application projects.
4. Be able to design the multi-channel data acquisition system and transmitter

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Expt. No.	List of equipments
1.	Sufficient number of Monolithic Instrumentation amplifier , Operational amplifiers,IC 7805 and resistors, diodes, capacitors
2	Linear control valve, ON/OFF control valve, Air regulator, Rotameter, Pump
3	Sufficient number of IC 741, CRO, Bread board, Signal generator (PID) Microprocessor kit with ADC and DAC section
4	Any Process station (Temperature or Level) with Corresponding sensors, Data acquisition card, and Storage device (microcontroller/microprocessor)
5.	Flow process station with DP transmitter
6	Loop analyzer
7	Thermocouple & RTD
8	Bonded strain gauge, Loads,
9	orifice plate

EI8811 **PROJECT WORK** **L T P C**
0 0 20 10

OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three 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 project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

OUTCOMES:

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

EE8072 **MEMS AND NANO SCIENCE** **LT P C**
3 0 0 3

COURSE OBJECTIVES

- To provide wide knowledge of semiconductors and solid mechanics to fabricate MEMS devices
- To educate on the rudiments of Micro fabrication techniques
- To educate on applications of MEMS
- To provide wide information dealing with nano material and its necessity
- To analyze methods involving preparation of nano scale devices

UNIT I OVERVIEW OF MEMS AND MICROSYSTEMS 9

Introduction to MEMS and Microsystems, Need for Miniaturization, MEMS and Microsystem products: Micro gears - Micro turbines – Micromotors - Micro optical devices. Microsystems and Microelectronics, Application of Microsystems in Automotive Industries: Safety - Engine and power trains - Comfort and convenience, Microactuation: Actuation using thermal forces - actuation using shape memory alloys - Actuation using piezoelectric effect - Actuation using Electrostatic forces.

UNIT II MICROSYSTEM FABRICATION PROCESS 9

Photolithography, Ion Implantation, Diffusion, Oxidation: Thermal oxidation-Oxidation by color, Chemical Vapour Depostion, Physical Vapour Deposition: Sputtering, Etching: Chemical-Plasma, Micromaching: Bulk Micromachining - Surface Micromachining.

UNIT III POLYMERS AND OPTICAL MEMS 9

Polymers in MEMS : Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA –

Parylene – Fluorocarbon, Optical MEMS : Lenses and Mirrors – Actuators for Active Optical MEMS, Assembly of 3D MEMS – Foundry process.

UNIT IV INTRODUCTION TO NANOSCALE ENGINEERING 9

General Principle of Nano Fabrication, Nano products, Applications of Nano products, Quantum physics, Fluid flow in submicrometers and nanoscales : Rarefied Gas – Knudsen and match numbers – Modleing of micro and nanoscale gas flow, Heat Conduction at Nanoscale, Challenges in Nanoscale Engineering, New materials for NEMS.

UNIT V PATTERNING AND PREPARATION METHODS 9

Bottom up Synthesis – Top down Approach : Precipitation, Mechanical Milling, Colloidal routes, Self assembly, Vapour phase deposition, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE, Patterning : Introduction to optical/UV electron beam and X-ray Lithography systems and processes. Clean rooms: specifications and design, air and water purity, requirements for particular processes.

TOTAL :45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the operation of micro devices, micro systems and their applications.
2. Ability to design the micro devices, micro systems using the MEMS fabrication process.
3. Ability to understand the operation of nao devices, nano systems and their applications.
4. Ability to design nano devices, nano systems using the preparation methods.

TEXT BOOKS:

1. Tai Ran Hsu “MEMS and Microsystems Design : Manufacture and Nano Scale Engineering”, John Wiely & Sons, INC., 2nd Edition, 2008.

2. A.S. Edelstein and R.C. Cammearata, eds., Nanomaterials: Synthesis, Properties and Applications, (Institute of Physics Publishing, Bristol and Philadelphia, 1996).

REFERENCES:

1. Chang Liu, ‘Foundations of MEMS’, Pearson Education Inc., 2012.

2. Mohamed Gad-el-Hak, editor, “ The MEMS Handbook”, CRC press Baco Raton, 2001.

3. Nadim Maluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000..

4. G Timp (Editor), Nanotechnology, AIP press/Springer, 1999.

5. N John Dinardo, Nanoscale charecterisation of surfaces & Interfaces, Second edition, Weinheim Cambridge, Wiley-VCH, 2000.

EI8077 POWER ELECTRONICS AND DRIVES LT P C
3 0 0 3

COURSE OBJECTIVES

- Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics
- Give exposure to Various topologies, working principle and analysis of controlled rectifiers and ac controllers
- Detailed knowledge on Classifications, structure, operating principle of dc choppers
- Introduction to different types of Inverters , their principle of operation and waveform control
- Overview on dc and ac drives and their control using power electronic circuits.

UNIT I POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS 9

Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO, MCT, Power integrated circuits (PIC) – Drive and Protection circuits – Series and parallel operation – Commutation – Simulation tools.

UNIT II CONTROLLED RECTIFIERS AND AC CONTROLLERS 9

Single phase – Three phase – Half controlled – Fully controlled rectifiers – Dual converters -Effect of source and load inductance - AC voltage controllers –Introduction to Cycloconverters, Matrix converters.

UNIT III DC TO DC CONVERTERS 9

Step up and Step down Chopper – Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators.

UNIT IV INVERTERS 9

Voltage source Inverters – Half bridge – Full bridge – Three Phase Bridge Inverters – Voltage control– PWM Techniques – Current Source Inverters: Capacitor Commutated Inverter- Resonant inverters: Series, Parallel, ZVS, ZCS – Introduction to multilevel Inverters.

UNIT V DRIVES AND CONTROL 9

Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only) – Introduction to vector control of AC drives.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to explain various devices and their structure, operating characteristics in the field of electronics.
2. Ability to classify, analyze and design, Control rectifier, chopper and inverter.
3. Will have ability to apply power electronic circuits for the control of popular applications.
4. Exposure to design and analyze PE circuit using simulation software.

TEXT BOOKS:

1. Rashid, M.H., “Power Electronics – Circuits, Devices and Applications”, PHI, 3rd Edition, 2004.
2. Mohan, Udeland and Robbins., “Power Electronics”, John Wiley and Sons, New York, 1995.

REFERENCES:

1. Singh, M.D., and Khanchandani, K.B., “Power Electronics”, 2nd Edition., Tata McGraw-Hill, 2011.
2. Bose, B.K., “Modern Power Electronics and AC Drives”, Pearson Education, 2002.

3. Bimbra, P.S., “Power Electronics”, Khanna Publishers, 2006.
4. Moorthi, V.R., “Power Electronics - Devices, Circuits and Industrial Applications”, Oxford University Press, 2005.
5. NPTEL Lecture Series on “Power Electronics” by Dr.B.G.Fernandes, IIT Bombay.

IC8072 SYSTEM IDENTIFICATION LT P C
2 2 0 3

COURSE OBJECTIVES

- To understand the mathematical modelling of systems.
- To observe systems by their behaviour using Parametric Identification methods using online and offline Data’s
- To observe systems by their behaviour using Nonparametric Identification Methods using Online and Offline Data’s
- To estimate and validate the data’s using parametric and recursive estimation methods
- To perform case studies on electromechanical and process control systems

UNIT I NONPARAMETRIC IDENTIFICATION 6+6

Transient and frequency analysis methods, impulse and step response methods, correlation method, spectral analysis.

UNIT II PARAMETRIC INDENTIFICATION 6+6

Steps in identification process, determining model structure and dimension, Linear and nonlinear model structures (ARX, ARMAX, Box-Jenkins, FIR, Output Error models), Input signals: commonly used signals, spectral properties, and persistent excitation, Residual analysis for determining adequacy of the estimated models.

UNIT III PARAMETRIC ESTIMATION 6+6

Linear regression, least square estimation, statistical analysis of LS methods, Minimizing prediction error- identifiability, bias, Least squares, relation between minimizing the prediction error and the MLE, MAP, Convergence and consistency, asymptotic distribution of parameter estimates, Instrumental Variable Method.

UNIT IV RECURSIVE ESTIMATION 6+6

Forgetting Factor method, Kalman Filter interpretation Identification in practice: Aliasing due to sampling, closed loop data, model order estimation, robustness considerations, model validation.

UNITV CASE STUDIES 6+6

Electro Mechanical Systems, Process Control Systems using Matlab/Equivalent System Identification Toolbox.

TOTAL: 60 PERIODS

COURSE OUTCOMES (COs)

1. Be familiar with different model structures, parameterization, identifiability, structure determination and order estimation
2. Be able to perform parameter estimation using different identification techniques
3. Be able to identify plants online using recursive estimation methods
4. Be able to set up an experiment, identify a nominal model, assess the accuracy and precision of this model,
5. Be appropriate design choices to arrive at a validated model.

REFERENCES:

1. jung, L. System Identification: Theory for the User, 2nd Edition, Prentice-Hall, 1999, ISBN 0-13-656695-2.
2. Torsten Soderstrom, PetreStoica, System Identification, Prentice Hall International (UK) Ltd. 1989.
3. Karel J. Keesman, System Identification, An introduction, Springer, 2011.
4. Zhu, Y. Multivariable System Identification for Process Control, Pergamon, 2001.
5. Landan ID, "System Identification and Control Design," Prentice Hall
6. ArunK.Tangirala,Principles of System Identification: Theory and Practice,CRC Press,2014.

EI8074 COMPUTER NETWORKS L T P C
2 2 0 3

OBJECTIVES:

The student should be made to:

- Understand the division of network functionalities into layers.
- Be familiar with the components required to build different types of networks
- Be exposed to the required functionality at each layer
- Learn the flow control and congestion control algorithms
- Understand the flow of traditional and Ongoing applications.

UNIT I FUNDAMENTALS & LINK LAYER 6+6

Building a network – Requirements - Layering and protocols - Internet Architecture – Network software – Performance ; Link layer Services - Framing - Error Detection - Flow control

UNIT II MEDIA ACCESS & INTERNETWORKING 6+6

Media access control - Ethernet (802.3) - Wireless LANs – 802.11 – Bluetooth - Switching and bridging – Basic Internetworking (IP, CIDR, ARP, DHCP,ICMP)

UNIT III ROUTING 6+6

Routing (RIP, OSPF, metrics) – Switch basics – Global Internet (Areas, BGP, IPv6), Multicast – addresses – multicast routing (DVMRP, PIM)

UNIT IV TRANSPORT LAYER 6+6

Overview of Transport layer - UDP - Reliable byte stream (TCP) - Connection management – Flow control - Retransmission – TCP Congestion control - Congestion avoidance (DECbit, RED) – QoS – Application requirements

UNIT V APPLICATION LAYER 6+6

Traditional applications -Electronic Mail (SMTP, POP3, IMAP, MIME) – HTTP – Web Services – DNS - SNMP.

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Identify the components required to build different types of networks
- Choose the required functionality at each layer for given application
- Identify solution for each functionality at each layer
- Trace the flow of information from one node to another node in the network
- Identify the congestion control and Avoidance
- Learn the tradition applications and web services

TEXT BOOK:

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Fifth Edition, Morgan Kaufmann Publishers, 2011.

REFERENCES:

1. James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down Approach Featuring the Internet”, Fifth Edition, Pearson Education, 2009.
2. Nader. F. Mir, “Computer and Communication Networks”, Pearson Prentice Hall Publishers, 2010.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill Publisher, 2011.
4. Behrouz A. Forouzan, “Data communication and Networking”, Fourth Edition, Tata McGraw – Hill, 2011.

GE8075 INTELLECTUAL PROPERTY RIGHTS L T P C
3 0 0 3

OBJECTIVE:

- To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION 9

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs 10

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad

UNIT III AGREEMENTS AND LEGISLATIONS 10

International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW 9

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs 7

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL:45 PERIODS

OUTCOME:

- Ability to manage Intellectual Property portfolio to enhance the value of the firm.

TEXT BOOKS

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCES:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition, 2012.
2. Prabuddha Ganguli,"Intellectual Property Rights: Unleashing the Knowledge Economy", McGraw Hill Education, 2011.
3. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

EI8071 ADAPTIVE CONTROL LT P C
2 2 0 3

OBJECTIVE

- To study the definition of adaptive control and methods of adaptation.
- To study the parameter identification of systems.
- To study the self-tuning of PID controllers based on parameter identification.
- To study the model reference adaptive control.
- To study the practical application through case studies.

UNIT I INTRODUCTION 6+6

Introduction to adaptive control – Effects of process variations –Adaptive control schemes – Adaptive control problem – Non-parametric identification – Step response method – Impulse response method – Frequency response method.

UNIT II PARAMETRIC IDENTIFICATION 6+6

Linear in parameter models - ARX – ARMAX – ARIMAX – Least square estimation – Recursive least square estimation – Extended least square estimation – Maximum likelihood estimation – Introduction to non-linear systems identification - Pseudo random binary sequence.

UNIT III SELF-TUNING REGULATOR 6+6

Deterministic in-direct self-tuning regulators – Deterministic direct self-tuning regulators -Introduction to stochastic self-tuning regulators – Stochastic indirect self-tuning regulator.

UNIT IV MODEL REFERENCE ADAPTIVE CONTROLLER 6+6

The MIT rule – Lyapunov theory – Design of model reference adaptive controller using MIT rule and Lyapunov theory – Relation between model reference adaptive controller and self-tuning regulator.

UNIT V TUNING OF CONTROLLERS AND CASE STUDIES 6+6

Design of gain scheduling controller - Auto-tuning of PID regulator – Stability analysis of adaptive controllers – Application of adaptive control in chemical reactor, distillation column and variable area tank system.

TOTAL : 60 PERIODS

COURSE OUTCOMES

1. Understand the effect of parameter variation and principle of adaptive control schemes.
2. Distinguish different parametric identification methods.
3. Understand Deterministic and Stochastic Self Tuning Regulators.
4. Design of model reference adaptive controller
5. Design gain scheduling controller and apply adaptive control schemes for industrial processes.

TEXT BOOKS:

1. Karl J. Astrom & Bjorn Wittenmark, 'Adaptive Control', Pearson Education (Singapore), Second Edition, 2003.
2. Shankar Sastry and Marc Bodson, 'Adaptive Control: Stability, Convergence, and Robustness', Prentice-Hall, 1994.
3. I. D. Landau, R. Lozano, and M. M'Saad, 'Adaptive Control', NY: Springer-Verlag, 1998.

REFERENCES:

1. Chalam, 'Adaptive Control Systems: Techniques and Applications', CRC Press, 1987.
2. Landau, I.D., Lozano, R., M'Saad, M., Karimi, A, 'Adaptive Control Algorithms, Analysis and Applications', 2nd edition, Springer, 2011
3. T. C.H.A. Hsia, 'System Identification', Lexington books, 1974.
4. Stephanopoulis G. 'Chemical Process Control', Prentice Hall of India, New Delhi, 1990.
5. Miroslav Krstic, Ioannis Kanellakopoulos, Petar V. Kokotovic, 'Nonlinear and Adaptive Control Design', 1st Edition, Wiley, 1995.
6. Gang Tao, 'Adaptive Control Design and Analysis', Wiley-IEEE Press, 2003,
7. Kumpati S. Narendra, Anuradha M. Annaswamy, 'Stable Adaptive Control Systems', Prentice Hall, 1989.

EI8072 ADVANCED INSTRUMENTATION SYSTEMS LT P C
3 0 0 3

COURSE OBJECTIVES

- To make the students review the instruments used for measurement of basic process parameters like level, flow, pressure and temperature.
- To explore the various types of analyzers used in industrial applications.

- To make the students to understand the requirement of safety instrumented system, standards and risk analysis techniques
- To make students familiarize with Instrumentation standards such as BS1042, ISA 75, ISA 84 and ISA 88.
- To make students familiarize with Instrumentation Symbols, Abbreviations and Identification for Instruments, Process Flow diagrams, Instrument Loop diagrams, Instrument Hookup diagrams and Piping and Instrumentation Diagrams.

UNIT I MEASUREMENT OF PROCESS PARAMETERS 9

Review the various Measurement techniques of temperature, pressure, flow and level – application - selection of sensors– calibration methods.

UNIT II INSTRUMENTS FOR ANALYSIS 9

Ion selective electrodes : Gas & Liquid Chromatography - Oxygen analyzers for gas and liquid – CO, CO2, NO and SO Analyzers- Hydrocarbon and HS Analyzers – Dust Analyzers, smoke Analyzers, Toxic gas Analyzers and radiation monitoring.

UNIT III SAFETY INSTRUMENTATION 9

Introduction to Safety Instrumented Systems – Hazards and Risk – Process Hazards Analysis (PHA) – Safety Life Cycle – Control and Safety Systems - Safety Instrumented Function - Safety Integrity Level (SIL) – Selection, Verification and Validation.

UNIT IV INSTRUMENTATION STANDARDS 9

Instrumentation Standards - significance of codes and standards – overview of various types - Introduction of various Instrumentation standards – review, interpretation and significance of specific standards - examples of usage of standards on specific applications.

UNIT V DOCUMENTATION IN PROCESS INDUSTRIES 9

Block Diagram of a Typical Process – Instrumentation Symbols, Abbreviations and Identification for Instruments: - Mechanical Equipment, Electrical Equipment, Instruments and Automation Systems - Process Flow Diagram (PFD) – Piping and Instrumentation Diagram (P&ID) -Instrument Lists and Specification – Logic Diagrams – Instrument Loop Diagrams - Instrument Hookup Diagrams – Location Plans for Instruments - Cable Routing Diagrams – Typical Control / Rack Rooms Layout – Vendors Documents and Drawings

TOTAL: 45 PERIODS

COURSE OUTCOMES

Students will be able to

- understand the instrumentation behind flow, level, temperature and pressure measurement
- Acquire basic knowledge on the various types of analyzers used in typical industries.
- Understand the role of Safety instrumented system in the industry.
- Explain Standards for applying Instrumentation in Hazards Locations.
- Design, develop, and interpret the documents used to define instruments and control
- Systems for a typical project, including P&IDs, loop diagrams, specification forms,
- Instrument lists, logic diagrams, installation details, and location plans

TEXT BOOKS

1. B.G.Liptak, “Instrumentation Engineers Handbook (Process Measurement & Analysis)”, Fourth Edition, Chilton Book Co, CRC Press, 2005.

REFERENCE BOOKS

1. Swapan Basu, “Plant Hazard analysis and Safety Instrumentation systems” Academic Press, 2016
2. Al.Sutko,Jerry.D.Faulk, “Industrial Instrumentation”, Delmar publishers, 1996.

3. Paul Gruhn, P.E., CFSE and Harry Cheddie, P.E., “Safety Instrumented Systems: Design, Analysis, and Justification”, 2nd Edition, ISA 2006.
4. Safety - ANSI/ISA84.00.01-2004, Part 1: Framework, Definitions, System Hardware and Software Requirements; ANSI/ISA84.00.01-2004, Part 2: Functional Safety: Safety Instrumented Systems for the Process Industry Sector; ANSI/ISA84.00.01-2004, Part 3: Guidance for the Determination of the Required Safety Integrity Levels-Informative.
5. Standards - ANSI/ISA-75.01.01 -2002 (60534-2-1 Mod): Flow Equations for Sizing control Valves; ISA84 Process Safety Standards and User Resources, Second Edition, ISA, 2011; ISA88 Batch Standards and User Resources, 4th Edition, ISA, 2011.
6. Documentation Standards - ANSI/ISA5.4-1991 - Instrument Loop Diagrams; ANSI/ISA5.06.01-2007 - Functional Requirements Documentation for Control Software Applications; ANSI/ISA20-1981 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

EE8071 APPLIED SOFT COMPUTING LT P C
3 0 0 3

OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks
- To provide adequate knowledge about fuzzy and neuro-fuuzy systems
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems.

UNIT I ARCHITECTURES – ANN 9

Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm- Back propagation network.

UNIT II NEURAL NETWORKS FOR CONTROL 9

Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum.

UNIT III FUZZY SYSTEMS 9

Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules - Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system.

UNIT IV APPLICATION OF FUZZY LOGIC SYSTEMS 9

Fuzzy logic control: Home heating system - liquid level control - aircraft landing- inverted pendulum – fuzzy PID control, Fuzzy based motor control.

UNIT V GENETIC ALGORITHMS 9

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters- Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.
- To understand and apply computing platform and software for engineering problems.

TEXT BOOKS:

1. Laurance Fausett, Englewood Cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 3rd Edition , 2010..
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013

REFERENCES:

1. Simon Haykin, 'Neural Networks', Pearson Education, 2003.
2. John Yen & Reza Langari, 'Fuzzy Logic – Intelligence Control & Information', Pearson Education, New Delhi, 2003.
3. M.Gen and R,Cheng, Genetic algorithms and optimization, Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.
6. William S.Levine, "Control System Advanced Methods," The Control Handbook CRC Press 2011.

EI8075 FIBRE OPTICS AND LASER INSTRUMENTS LT P C
3 0 0 3

AIM:

To contribute to the knowledge of Fibre optics and Laser Instrumentation and its Industrial andMedical Application.

COURSE OBJECTIVES

- To expose the students to the basic concepts of optical fibres and their properties.
- To provide adequate knowledge about the Industrial applications of optical fibres.
- To expose the students to the Laser fundamentals.
- To provide adequate knowledge about Industrial application of lasers.
- To provide adequate knowledge about holography and Medical applications of Lasers.

UNIT I OPTICAL FIBRES AND THEIR PROPERTIES 9

Construction of optical fiber cable: Guiding mechanism in optical fiber and Basic component of optical fiber communication, –Principles of light propagation through a fibre: Total internal reflection, Acceptance angle (θa), Numerical aperture and Skew mode, –Different types of fibres and their properties: Single and multimode fibers and Step index and graded index fibers,– fibrecharacteristics: Mechanical characteristics and Transmission characteristics, – Absorption losses – Scattering losses – Dispersion – Connectors and splicers –Fibre termination – Optical sources: Light Emitting Diode (LED), – Optical detectors: PIN Diode.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBRES 9

Fibre optic sensors: Types of fiber optics sensor, Intrinsic sensor- Temperature/ Pressure sensor, Extrinsic sensors, Phase Modulated Fibre Optic Sensor and Displacement sensor (Extrinsic Sensor) – Fibre optic instrumentation system: Measurement of attenuation (by cut back method), Optical domain reflectometers, Fiber Scattering loss Measurement, Fiber Absorption Measurement, Fiber dispersion measurements, End reflection method and Near field scanning techniques – Different types of modulators: Electro-optic modulator (EOM) –Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Level Lasers: Two-Level Laser, Three Level Laser, Quasi Three and four level lasers – Properties of laser: Monochromaticity, Coherence, Divergence and Directionality and Brightness –Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers; – Gas lasers, solid lasers, liquid lasers and semiconductor lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

Laser for measurement of distance, Laser for measurement of length, Laser for measurement of velocity, Laser for measurement of acceleration, Laser for measurement of current, voltage and Laser for measurement of Atmospheric Effect: Types of LIDAR, Construction And Working, and LIDAR Applications – Material processing: Laser instrumentation for material processing, Powder Feeder, Laser Heating, Laser Welding, Laser Melting, Conduction Limited Melting and Key Hole Melting – Laser trimming of material: Process Of Laser Trimming, Types Of Trim, Construction And Working Advantages – Material Removal and vaporization: Process Of Material Removal.

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography: Basic Principle, Holography vs. photography, Principle Of Hologram Recording, Condition For Recording A Hologram, Reconstructing and viewing the holographic image– Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser-Tissue Interactions Photochemical reactions, Thermalisation, collisional relaxation, Types of Interactions and Selecting an Interaction Mechanism – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs):

1. Understand the principle, transmission, dispersion and attenuation characteristics of opticalfibers
2. Apply the gained knowledge on optical fibers for its use as communication medium and as sensor as well which have important applications in production, manufacturing industrial and biomedical applications.
3. Understand laser theory and laser generation system.
4. Students will gain ability to apply laser theory for the selection of lasers for a specific Industrial and medical application.

TEXT BOOKS:

1. J.M. Senior, 'Optical Fibre Communication – Principles and Practice', Prentice Hall of India,1985.
2. J. Wilson and J.F.B. Hawkes, 'Introduction to Opto Electronics', Prentice Hall of India, 2001.
3. Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.

REFERENCES:

1. G. Keiser, 'Optical Fibre Communication', McGraw Hill, 1995.
2. M. Arumugam, 'Optical Fibre Communication and Sensors', Anuradha Agencies, 2002.

3. John F. Ready, “Industrial Applications of Lasers”, Academic Press, Digitized in 2008.
4. Monte Ross, ‘Laser Applications’, McGraw Hill, 1968.
5. John and Harry, “Industrial lasers and their application”, McGraw-Hill, 2002.
6. Keiser, G., “Optical Fiber Communication”, McGraw-Hill, 3rd Edition, 2000.
http://nptel.ac.in/courses/117101002/

EE8391	ELECTROMAGNETIC THEORY	L	T	P	C
		2	2	0	3

OBJECTIVES:

- To introduce the basic mathematical concepts related to electromagnetic vector fields
- To impart knowledge on the concepts of
  - ✓ Electrostatic fields, electrical potential, energy density and their applications.
  - ✓ Magneto static fields, magnetic flux density, vector potential and its applications.
  - ✓ Different methods of emf generation and Maxwell’s equations
  - ✓ Electromagnetic waves and characterizing parameters

UNIT I ELECTROSTATICS – I 6+6

Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb’s Law – Electric field intensity – Field due to discrete and continuous charges – Gauss’s law and applications.

UNIT II ELECTROSTATICS – II 6+6

Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson’s and Laplace’s equations, Capacitance, Energy density, Applications.

UNIT III MAGNETOSTATICS 6+6

Lorentz force, magnetic field intensity (H) – Biot–Savart’s Law - Ampere’s Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson’s Equation, Magnetic force, Torque, Inductance, Energy density, Applications.

UNIT IV ELECTRODYNAMIC FIELDS 6+6

Magnetic Circuits - Faraday’s law – Transformer and motional EMF – Displacement current - Maxwell’s equations (differential and integral form) – Relation between field theory and circuit theory – Applications.

UNIT V ELECTROMAGNETIC WAVES 6+6

Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.

TOTAL : 60 PERIODS

OUTCOMES:

- Ability to understand the basic mathematical concepts related to electromagnetic vector fields.

- Ability to understand the basic concepts about electrostatic fields, electrical potential, energy density and their applications.
- Ability to acquire the knowledge in magneto static fields, magnetic flux density, vector potential and its applications.
- Ability to understand the different methods of emf generation and Maxwell's equations
- Ability to understand the basic concepts electromagnetic waves and characterizing parameters
- Ability to understand and compute Electromagnetic fields and apply them for design and analysis of electrical equipment and systems

TEXT BOOKS:

1. Mathew N. O. Sadiku, 'Principles of Electromagnetics', 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', McGraw Hill Special Indian edition, 2014.
3. Kraus and Fleish, 'Electromagnetics with Applications', McGraw Hill International Editions, Fifth Edition, 2010.

REFERENCES

1. V.V.Sarwate, 'Electromagnetic fields and waves', First Edition, Newage Publishers, 1993.
2. J.P.Tewari, 'Engineering Electromagnetics - Theory, Problems and Applications', Second Edition, Khanna Publishers.
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), McGraw Hill, 2010.
4. S.P.Ghosh, Lipika Datta, 'Electromagnetic Field Theory', First Edition, McGraw Hill Education(India) Private Limited, 2012.
5. K A Gangadhar, 'Electromagnetic Field Theory', Khanna Publishers; Eighth Reprint : 2015

GE8071 DISASTER MANAGEMENT LT P C
3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXTBOOKS:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13**:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

GE8074 **HUMAN RIGHTS** **LT P C**
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

MG8491 **OPERATIONS RESEARCH** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems.

UNIT I LINEAR MODELS **15**

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.

UNIT II TRANSPORTATION MODELS AND NETWORK MODELS 8

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.

UNIT III INVENTORY MODELS 6

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.

UNIT IV QUEUEING MODELS 6

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.

UNIT V DECISION MODELS 10

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of this course, the students can able to use the optimization techniques for use engineering and Business problems

TEXT BOOK:

1. Hillier and Libeberman, “Operations Research”, Holden Day, 2005
2. Taha H.A., “Operations Research”, Sixth Edition, Prentice Hall of India, 2003.

REFERENCES:

1. Bazara M.J., Jarvis and Sherali H., “Linear Programming and Network Flows”, John Wiley, 2009.
2. Budnick F.S., “Principles of Operations Research for Management”, Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., “Operations Research”, John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., “Operation Research for Management”, Wiley Eastern, 1994.
5. Tulsian and Pasdey V., “Quantitative Techniques”, Pearson Asia, 2002.

EI8092 THERMAL POWER PLANT INSTRUMENTATION LT P C
3 0 0 3

COURSE OBJECTIVES

- To make the students familiarize about various power generation methods.
- To identify various parameters in thermal power plant
- To impart knowledge about the different types of controls and control loops.
- To familiarize the student with the methods of monitoring different parameters like speed, vibration of turbines and their control.

UNIT I POWER GENERATION METHODS 9

Brief survey of methods of power generation: hydro, thermal, nuclear, solar and wind power – importance of instrumentation in power generation – thermal power plants: building blocks, details of boiler processes P&I diagram of boiler – cogeneration.

UNIT II MEASUREMENTS IN POWER PLANTS 9

Electrical measurements: current, voltage, power, frequency, power factor – non electrical parameters: flow of feed water, fuel, air, steam pressure and steam temperature – smoke density measurement – Flue gas oxygen analyzer – pollution monitoring instruments.

UNIT III FURNACE CONTROL 9

Coal handling: Pulverizers - Furnace Draught: natural draught, forced draught, induced draught, power requirements for draught systems - Combustion control: Fuel/Air ratio, combustion efficiency, excess air, parallel and cross limited combustion control- soot-blowing operation.

UNIT IV BOILER CONTROL 9

Boiler metal temperature measurement, pressure measuring devices – Boiler feed water processing and control - drum level measurement methods - steam temperature control: main steam and reheat steam temperature control, superheater control, deaerator control – distributed control system in power plants – interlocks in boiler operation.

UNIT V TURBINE CONTROL 9

Speed measurement, rotor and casing movement- vibration - shell temperature monitoring and control - steam pressure control - lubricant oil temperature - cooling system.

TOTAL : 45 PERIODS

COURSE OUTCOME:

1. Understanding various power generation process.
2. Identify important parameter to be monitored and controlled in thermal power plant.
3. Knowledge about various building blocks and instruments involved in thermal power plant and its controlling process.

TEXT BOOKS

1. Sam G. Dukelow, The control of Boilers, instrument Society of America, 1991.
2. Modern Power Station Practice, Vol.6, Instrumentation, Controls and Testing, Pergamon Press, Oxford, 1971.

REFERENCES

1. Krishnaswamy KM, Bala P, Bala MP, “Power Plant Instrumentation,” Prentice Hall, 2013
2. Elonka.S.M.and Kohal A.L., Standard Boiler Operations, McGraw-Hill, New Delhi, 1994.
3. Jain R.K., Mechanical and industrial Measurements, Khanna Publishers, New Delhi, 2008

EC8091 ADVANCED DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn and understand the concepts of stationary and non-stationary random signals and analysis & characterization of discrete-time random processes
- To enunciate the significance of estimation of power spectral density of random processes
- To introduce the principles of optimum filters such as Wiener and Kalman filters
- To introduce the principles of adaptive filters and their applications to communication engineering
- To introduce the concepts of multi-resolution analysis

UNIT I DISCRETE-TIME RANDOM PROCESSES 9

Random variables - ensemble averages a review, random processes - ensemble averages, autocorrelation and autocovariance matrices, ergodic random process, white noise, filtering random processes, spectral factorization, special types of random processes - AR, MA, ARMA.

UNIT II SPECTRUM ESTIMATION 10

Bias and consistency, Non-parametric methods - Periodogram, modified-Periodogram - performance analysis. Bartlett's method, Welch's method, Blackman-Tukey method. Performance comparison. Parametric methods - autoregressive (AR) spectrum estimation - autocorrelation method, Prony's method, solution using Levinson Durbin recursion.

UNIT III OPTIMUM FILTERS 9

Wiener filters - FIR Wiener filter - discrete Wiener Hopf equation, Applications - filtering, linear prediction. IIR Wiener filter - causal and non-causal filters. Recursive estimators - discrete Kalman filter.

UNIT IV ADAPTIVE FILTERS 9

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms - steepest descent algorithm, the LMS algorithm - convergence. Applications of adaptive filtering - noise cancellation, channel equalization.

UNIT V MULTIRESOLUTION ANALYSIS 8

Short-time Fourier transform - Heisenberg uncertainty principle. Principles of multi-resolution analysis - sub-band coding, the continuous and discrete wavelet transform - properties. Applications of wavelet transform - noise reduction, image compression.

TOTAL:45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Articulate and apply the concepts of special random processes in practical applications
- Choose appropriate spectrum estimation techniques for a given random process
- Apply optimum filters appropriately for a given communication application
- Apply appropriate adaptive algorithm for processing non-stationary signals
- Apply and analyse wavelet transforms for signal and image processing based applications

TEXT BOOKS

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008. (UNIT I-IV).

2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993 (UNIT V)

REFERENCES:

1. John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing – Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000

EI8076 OPTIMAL CONTROL LT P C
2 2 0 3

OBJECTIVES:

- To understand the optimal control concepts and its importance
- To study the important optimal control methods existing in the industries in order obtain the required level of control
- To introduce the concept of optimal control in various system
- To help the learners in the design and the implementation of the concept of optimal control
- To study, analyze and implement discrete-Time optimal control system

UNIT I INTRODUCTION 6+6

Introduction to Optimal control – Comparison between the Conventional control and optimal control procedures - Statement of optimal control problem – Problem formulation and forms of optimal Control – Selection of performance measures. Necessary conditions for optimal control.

UNIT II MATHEMATICAL EVALUATION 6+6

Introduction and Performance Index - Basic Concept of calculus of variation- The basic variational problem - Fixed end point problem - Free end point problem - Variational Approach to Optimal Control Systems.

UNIT III CONTROL STRATEGY 6+6

Introduction - Time varying optimal control – LQR steady state optimal control – Frequency Domain Interpretation of LQR (LTI system) - Solution of Ricatti’sequation – Application examples.

UNIT IV PROBLEM FORMATION 6+6

Optimal Control: Introduction, formation of optimal control problem, calculus of variations minimization of functions, constrained optimization. Pontryagin’s Minimum/Maximum Principle, Linear Quadratic Problem-Hamilton Jacobi equation and its solution.

UNIT V ADVANCED SYSTEMS 6+6

Discrete-Time Optimal Control Systems - Matrix Discrete Riccati Equation - Analytical Solution of Matrix Difference Riccati Equation - Optimal Control Using Dynamic Programming - The Hamilton-Jacobi-Bellman (HJB) Equation - LQR System HJB Equation-Time Optimal Control System.

TOTAL : 60 PERIODS

OUTCOMES:

1. Problem formulation, forms of optimal control and its necessary conditions.
2. Solving the algebraic equations to design the controller and to study about various problems
3. Designing optimal controllers using a class of procedures
4. Predict the system dynamic behavior through solution of ODEs and formation of optimal control problem

5. Solve equations to design the controllers in discrete methods representing spatial and temporal variations in physical systems through numerical methods.
6. Implementing the Optimal control methodology for the benchmark /real time systems.

TEXT BOOKS:

1. Kirk, D.E., Optimal Control Theory, Dover Publications, 2004.
2. D.S.Naidu, “Optimal Control Systems” First Indian Reprint, CRC Press, 2009.
3. Astrom, K.J. Intro. Stochastic Control Theory, Dover Publications, 2006.

REFERENCES:

1. Gopal M, “Digital Control and State Variable Methods,” Tata McGraw-Hill
2. F.L.Lewis,OptimalControl,JohnWiley&Sons,Inc.,NewYork,NY,1986
3. M.Gopal,ModernControlSystemTheory,NewAgeInternational
4. SageA.P.&WhiteC.C.,Optimum Systems Control, PrenticeHall
5. http://nptel.ac.in/courses/108105019/

TL8071	RADAR AND NAVIGATIONAL AIDS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To apply Doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars
- To refresh principles of antennas and propagation as related to radars, also study of transmitters and receivers.
- To understand principles of navigation, in addition to approach and landing aids as related to navigation

UNIT I INTRODUCTION TO RADAR EQUATION 9

Introduction- Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies –Applications of Radar – The Origins of Radar - Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of Radar Pulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters- System losses – Other Radar Equation Considerations.

UNIT II MTI AND PULSE DOPPLER RADAR 9

Introduction to Doppler and MTI Radar- Delay –Line Cancellers- Staggered Pulse Repetition Frequencies –Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI from a Moving Platform (AMIT) – Pulse Doppler Radar – Other Doppler Radar Topics- Tracking with Radar –Monopulse Tracking –Conical Scan and Sequential Lobing - Limitations to Tracking Accuracy - Low-Angle Tracking - Tracking in Range - Other Tracking Radar Topics - Comparison of Trackers - Automatic Tracking with Surveillance Radars (ADT).

UNIT III DETECTION OF SIGNALS IN NOISE 9

Matched –Filter Receiver –Detection Criteria – Detectors –-Automatic Detector - Integrators - Constant-False-Alarm Rate Receivers - The Radar operator - Signal Management - Propagation Radar Waves - Atmospheric Refraction -Standard propagation - Nonstandard Propagation - The Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters - Frequency-Scan Arrays

Radar Transmitters and Receivers - Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron - Crossed Field Amplifiers - Other RF Power Sources – Other

aspects of Radar Transmitter.**-** The Radar Receiver - Receiver noise Figure – Super heterodyne Receiver - Duplexers and Receiver Protectors- Radar Displays.

UNIT IV RADIO DIRECTION AND RANGES 9

Introduction - Four methods of Navigation .**-** The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - The Goniometer - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at Very High Frequencies - Automatic Direction Finders – The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders **-** The LF/MF Four course Radio Range - VHF Omni Directional Range(VOR) - VOR Receiving Equipment - Range and Accuracy of VOR – Recent Developments.

Hyperbolic Systems of Navigation (Loran and Decca) - Loran-A - Loran-A Equipment - Range and precision of Standard Loran - Loran-C - The Decca Navigation System -Decca Receivers - Range and Accuracy of Decca - The Omega System.

UNIT V SATELLITE NAVIGATION SYSTEM 9

Distance Measuring Equipment - Operation of DME - TACAN - TACAN Equipment **-** Instrument Landing System - Ground Controlled Approach System - Microwave Landing System(MLS) The Doppler Effect - Beam Configurations -Doppler Frequency Equations - Track Stabilization - Doppler Spectrum - Components of the Doppler Navigation System - Doppler range Equation - Accuracy of Doppler Navigation Systems. Inertial Navigation **-** Principles of Operation - Navigation Over the Earth– Components of an Inertial Navigation System - Earth Coordinate Mechanization - Strapped-Down Systems - Accuracy of Inertial Navigation Systems-The Transit System - Navstar Global Positioning System (GPS).

TOTAL: 45 PERIODS

OUTCOMES:

After studying this course, Students will be able to

- Explain principles of navigation, in addition to approach and landing aids as related to navigation
- Derive and discuss the Range equation and the nature of detection.
- Describe about the navigation systems using the satellite.

TEXT BOOKS:

1. Merrill I. Skolnik ," Introduction to Radar Systems", 3rd Edition Tata Mc Graw-Hill 2003.. (For unit-1&2)
2. N.S.Nagaraja, “Elements of Electronic Navigation Systems”, 2nd Edition, TMH, 2000. (For unit-3,4&5)

REFERENCES

1. Peyton Z. Peebles:, "Radar Principles", John Wiley, 2004
2. J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004

GE8077 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:

- To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and

Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II TQM PRINCIPLES 9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY MANAGEMENT SYSTEM 9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--**ENVIRONMENTAL MANAGEMENT SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS.

TOTAL: 45 PERIODS

OUTCOME:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. ISO9001-2015 standards

EC8095	VLSI DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study the fundamentals of CMOS circuits and its characteristics.
- Learn the design and realization of combinational & sequential digital circuits.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
- Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR 9

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Nonideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.

Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmmit Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.

Timing Issues : Timing Classification Of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.

Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures.

Design for Testability: *Ad Hoc* Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

TOTAL : 45 PERIODS

OUTCOMES:

UPON COMPLETION OF THE COURSE, STUDENTS SHOULD ABLE TO

- Realize the concepts of digital building blocks using MOS transistor.
- Design combinational MOS circuits and power strategies.
- Design and construct Sequential Circuits and Timing systems.
- Design arithmetic building blocks and memory subsystems.
- Apply and implement FPGA design flow and testing.

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson , 2017.(UNIT I,II,V)
2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, ”Digital Integrated Circuits:A Design perspective”, Second Edition , Pearson , 2016. (UNIT III,IV)

REFERENCES

1. M.J. Smith, “Application Specific Integrated Circuits”, Addisson Wesley, 1997
2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim “CMOS Digital Integrated Circuits:Analysis & Design”,4th edition McGraw Hill Education,2013
3. Wayne Wolf, “Modern VLSI Design: System On Chip”, Pearson Education, 2007
4. R.Jacob Baker, Harry W.LI., David E.Boyee, “CMOS Circuit Design, Layout and Simulation”, Prentice Hall of India 2005.

EI8073 BIOMEDICAL INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopedic prostheses fixation.

TOTAL : 45 PERIODS

OUTCOMES: At the end of the course students will have the

- Ability to understand the philosophy of the heart, lung, blood circulation and respiration system.
- Ability to provide latest ideas on devices of non-electrical devices.
- Ability to gain knowledge on various sensing and measurement devices of electrical origin.
- Ability to understand the analysis systems of various organ types.
- Ability to bring out the important and modern methods of imaging techniques and their analysis.
- Ability to explain the medical assistance/techniques, robotic and therapeutic equipments.

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi,2nd edition, 2003
3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition, 2012

REFERENCES

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

EI8091 INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES L T P C
3 0 0 3

COURSE OBJECTIVES

- To introduce the students the method of oil recovery and the steps involved in oil gas production process.
- To make the students understand the process behavior of some of the important unit operations in petrochemical industry through mathematical model.
- To familiarize the students to apply knowledge to select the appropriate control strategy for the selective process.
- To provide information about the most important derivatives obtained from petroleum products.
- To help the students in understanding selection and maintenance of instruments in petrochemical industry.

UNIT I OIL EXTRACTION AND OIL GAS PRODUCTION 9

Techniques used for oil discovery – Oil recovery methods – oil rig system - Overview of oil gas production – oil gas separation – Gas treatment and compression – Control and safety systems.

UNIT II IMPORTANT UNIT OPERATIONS IN REFINERY 9

Distillation Column – Thermal cracking – Catalytic Cracking – Catalytic reforming – mathematical Modeling and selection of appropriate control strategy – Alkylation – Isomerization.

UNIT III DERIVATIVES FROM PETROLEUM 9

Derivatives from methane – Methanol Production – Acetylene production - Derivatives from acetylene —Derivatives from ethylene – Derivatives from propylene.

UNIT IV IMPORTANT PETROLEUM PRODUCTS & MEASUREMENTS 9

BTX from Reformate – Styrene – Ethylene oxide/Ethylene glycol – polyethylene – Polypropylene – PVC production. Parameters to be measured in refinery and petrochemical industry – Selection and maintenance of measuring instruments.

UNIT V SAFETY IN INSTRUMENTATION SYSTEMS 9

Hazardous zone classification – Electrical and Intrinsic safety – Explosion suppression and Deluge systems – Flame, fire and smoke detectors – leak detectors – Guidelines and standards – General SIS Design Configurations – Hazard and Risk Assessment – Failure modes – Operation and Maintenance.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Gain knowledge on oil gas production process and important unit operations in a refinery
2. Having gained the process knowledge, ability to develop and analyze mathematical model of selective processes.
3. Able to develop, analyze and select appropriate control strategy for selective unit operations in a refinery.
4. Gain knowledge on the most important chemical derivatives obtained from petroleum products. 5. Understand safety instrumentation followed in process industries.

TEXT BOOKS:

1. Waddams, A.L., “Chemicals from Petroleum”, Wiley, 1973. (digitized in 2007).
2. Balchen, J.G., and Mumme K.I., “Process Control Structures and Applications”, Von Nostrand Reinhold Company, New York, 1988.

REFERENCES:

1. Liptak, B.G., “Instrumentation in Process Industries”, Chilton Book Company, 2005. (Digitized in 2008.)
2. Austin, G.T. and Shreeves, A.G.T., “Chemical Process industries”, McGraw-Hill, 2012.
3. HavardDevold, “Oil and Gas Production Handbook”, ABB, 2006.
4. Paul Gruhn and Harry Cheddie, “Safety Instrumented Systems: Design, Analysis, and Justification”, 2nd Edition, ISA Press, 2006.

GE8076 PROFESSIONAL ETHICS IN ENGINEERING LT P C
3 0 0 3

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.

6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

MG8591 PRINCIPLES OF MANAGEMENT LT P C
3 0 0 3

OBJECTIVES:

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXT BOOKS:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES:

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998.
2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7th Edition, Pearson Education, 2011.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999

EI8078 PROJECT MANAGEMENT AND FINANCE LT P C
3 0 0 3

COURSE OBJECTIVES

- To understand what are the objectives of project management.
- To outline the principles followed in carrying out a project.
- To demonstrate knowledge and understanding of engineering and management principles.
- To function effectively as an individual, and as a member or leader in diverse teams.
- To understand the concepts of finance and accounts carried out in project management**.**

UNIT I PROJECT MANAGEMENT,PROJECT SELECTION AND PROJECT 9

Objectives of project management: Types of Projects: Project Management Life Cycle: Project Selection: Feasibility study: Estimation of Project Cost, Cost of Capital, Network analysis Techniques : PERT,CPM, Government regulations and statutory for various projects:

UNIT II PROJECT IMPLIMENTATION,MONITORING AND CONTROL 9

Project representation: Role of project managers ,relevance with objective of organization, preliminary manipulations ,Basic Scheduling concepts :Resource levelling ,Resource allocation ,Setting a base line, Project management information system: Importance of contracts in projects: Team work in Project Management: Formation of Effective terms.

UNIT III PROJECT EVALUATION, AUDITING AND OTHER RELATED TOPICS IN PROJECT MANAGEMENT 9

Project Evaluation: Project auditing: Phase of project audit Project closure reports, computers, e-markets in Project Management:

UNIT IV WORKING CAPITAL MANAGEMENT AND CAPITAL BUDGETING 9

Current assets management: Estimation of working capital requirements: Capital budgeting: Capital budgeting methods: Present value method: Accounting rate of return methods.

UNIT V FINANCE AND ACCOUNTING 9

Source of finance: Term Loans: Capital Structure: Financial Institution Accounting Principles: Preparation and Interpretation of balance sheets, profit and loss statements , Fixed Assets, Current assets, Depreciation methods :Break even analysis:

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to study the current market trends and choose projects.
2. Ability to prepare project feasibility reports.
3. Ability to implement the project effectively meeting government norms and conditions.
4. Ability to understand the role and responsibility of the Professional Engineer.
5. Be able to assess social, health, safety issues based on the reasoning received from the contextual knowledge.
6. Ability to choose projects which benefit the society and organization.

TEXT BOOKS:

1. Project Management Institute "A Guide to the Project Management Body of Knowledge" PMBOK® Guide (Sixth Edition), Sept 2017
2. James C.Van Horne, "Fundamentals of Financial Management", Person Education 2004.

REFERENCES:

1. **Küster** J., **Huber**, E., **Lippmann**, R., **Schmid**, A., **Schneider**, E., **Witschi**, U., **Wüst**, R." Project Management Handbook",2015
2. Khanna, R.B.,"Project Management", PHI 2011.
3. Prasanna Chandra, "Financial Management", Tata McGraw-Hill,2008.
4. By Carl S. Warren, James M. Reeve, Jonathan Duchac."Financial & Managerial Accounting",2016
5. PaneerSelvam, R., and Senthilkumar, P., "Project Management", PHI, 2011.

IC8071 ADVANCED PROCESS CONTROL LT P C
2 2 0 3

COURSE OBJECTIVES

- To teach students to build and analyze models for time-varying systems and non-linear systems.
- To develop the skills needed to design adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller for various applications
- To make the students learn to formulate optimal control schemes
- To provide basic knowledge about Fractional-order systems and Fractional-order- controller and to lay the foundation for the systematic approach to Design controller for fractional order systems
- To introduce FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

UNIT I CONTROL OF TIME-VARYING AND NONLINEAR SYSTEMS 6+6

Models for Time-varying and Nonlinear systems – Input signal design for Identification –Realtime parameter estimation – Model Validation - Types of Adaptive Control - Gain scheduling - Adaptive Control - Deterministic Self-tuning Controller and Model Reference Adaptive Controller – Control of Hammerstein and Wiener Systems.

UNIT II OPTIMAL CONTROL & FILTERING 6+6

Introduction – Performance Measure for optimal control problem – Dynamic Programming – Computational Procedure for solving Control Problem – LQR – Introduction to Optimal Filtering – Discrete Kalman Filter – Linear Quadratic Gaussian (LQG)

UNIT III FRACTIONAL ORDER SYSTEM & CONTROLLER 6+6

Fractional-order Calculus and Its Computations – Frequency and Time Domain Analysis of Fractional-Order Linear Systems - Filter Approximations to Fractional-Order Differentiations – Model reduction Techniques for Fractional Order Systems –Controller Design Studies for Fractional Order.

UNIT IV H-INFINITY CONTROLLER 6+6

Introduction – Norms for Signals – Robust Stability – Robust Performance – Small Gain Theorem – Optimal H2 Controller Design - H-Infinity Controller Design –– Effects of Weighting Functions in H-Infinity Control.

UNIT V FAULT DIAGNOSIS AND FAULT-TOLERANT CONTROL 6+6

Process Monitoring - Introduction – Statistical Process Control – Fault Detection with Principal Component Analysis – Fault Detection with State Observers – Fault Detection with signal models - Fault Detection of Control Loops- Sensor and Actuator Fault-Tolerant Control Design.

TOTAL: 60 PERIODS

COURSE OUTCOMES

- Ability to Apply knowledge of mathematics, science, and engineering to build and analyze models for time-varying systems and non-linear systems.
- Ability to design and implement adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller
- Ability to Identify, formulate, and solve optimal controller
- Ability to Analyze Fractional-order systems, Fractional-order- controller and Design controller for fractional order systems
- Ability to design and implement H2 and H-infinity Controllers
- Ability to use the FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

REFERENCE BOOKS

1 K.J. Astrom and B.J.Wittenmark, “Adaptive Control”, Pearson Education, Second Edition, 2008.

2 Donald E.Kirk, "Optimal Control Theory – An Introduction", Dover Publications, Inc. Mineola, New York, 2012

3 D.Xue, Y.Q.Chen, D.P.Atherton, "Linear Feedback Control Analysis and Design with MATLAB, Advances In Design and Control", Society for Industrial and Applied Mathematics, 2008.

4 R. Isermann, "Fault-Diagnosis Systems: An Introduction from Fault Detection to Fault Tolerance", Springer, 2006.

EI8093 UNIT OPERATION AND CONTROL LT P C
3 0 0 3

COURSE OBJECTIVES

- Study the unit operations involved for transportation, mixing and separation of solids.
- Study the unit operations involved for transportation, mixing and separation of fluids.
- Understand the basic operations involved with heat exchangers, Distillation and chemical reactions.

- Gain knowledge about the operations of evaporators and crystallizers, drying and cooling towers.
- Gain knowledge on the operation of dryers, distillation column, refrigerators and chemical reactors.

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, reboilers 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.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Apply the knowledge on solids & fluids to handle the raw materials.
2. Select and apply relevant handling techniques to convert the solids and fluids for specificapplications.
3. Come out with solutions for simple/complex problems in heat transfer and design the heatexchange equipment for different applications such as distillation, boilers.
4. Able to carry out multidisciplinary projects using heat transfer, mass transfer concepts.
5. Gain ability for lifelong learning of new techniques and developments in various types of unit operations in industries.

TEXT BOOKS:

1. Balchen ,J.G., and Mumme, K.J., " 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", McGraw-Hill International Edition, New York, Sixth Edition, 2001.

3. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, "Chemical Process Equipment :Selection and Design", Gulf Professional Publishing, 2010.

REFERENCES:

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”, McGraw-Hill International edition, USA, 1989.

EI8079 ROBOTICS AND AUTOMATION LT P C
3 0 0 3

AIM

To provide comprehensive knowledge of robotics in the design, analysis and control point of view.

COURSE OBJECTIVES

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the Euler, Lagrangian formulation of Robot dynamics.
- To study the trajectory planning for robot.
- To study the control of robots for some specific applications.
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

UNIT I BASIC CONCEPTS 9

Definition and origin of robotics – different types of robotics – various generations of robots – degrees of freedom – Robot classifications and specifications- Asimov’s laws of robotics – dynamic stabilization of robots.

UNIT II POWER SOURCES, SENSORS AND ACTUATORS 9

Hydraulic, pneumatic and electric drives: Design and controlissues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics – machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors.

UNIT III MANIPULATORS AND GRIPPERS DIFFERENTIAL MOTION 9

Construction of manipulators – manipulator dynamics and force control – electronic and pneumatic manipulator control circuits – end effectors – U various types of grippers – design considerations.

UNIT IV KINEMATICS AND PATH PLANNING 9

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist andarm singularity - Static analysis - Force and moment BalanceSolution kinematics problem – robot programming languages.

UNIT V DYNAMICS AND CONTROL AND APPLICATIONS 9

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulatorcontrol problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.Mutiple robots – machine interface – robots in manufacturing and non- manufacturing applications – robot cell design – selection of robot.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of the course, the student should be able to:

- Understand the evolution of robot technology and mathematically represent different types of robot.
- Get exposed to the case studies and design of robot machine interface.

- Familiarize various control schemes of Robotics control

TEXT BOOKS

1. Mikell P. Weiss G.M., Nagel R.N., Odraj N.G., Industrial Robotics, McGraw-Hill Singapore, 2015.
2. Saeed B Niku, Introduction to Robotics, Analysis, Systems, Applications Prentice Hall, 3 edition 2104.

REFERENCES

1. Deb.S.R., Robotics technology and flexible Automation, John Wiley, USA 1992.
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. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005
5. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education,2009.
6. Issac Asimov I Robot, Ballantine Books, New York, 1986.

GE8073 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

OBJECTIVES:

To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION 8

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 12

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays-functionalization and applications-Quantum wires, Quantum dots-preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

UNIT V APPLICATIONS **7**

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL : 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS :

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale Charecterisation of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

1. G Timp, “Nanotechnology”, AIP press/Springer, 1999.
2. Akhlesh Lakhtakia,“The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.