You Choose, We Do It

St. JOSEPH'S COLLEGE OF ENGINEERING

(An Autonomous Institution)

St. Joseph's Group of Institutions

Jeppiaar Educational Trust

OMR, Chennai - 119.

FACULTY OF ELECTRICAL ENGINEERING

REGULATION - 2021

B.E. - ELECTRONICS AND INSTRUMENTATION ENGINEERING

Choice Based Credit System (CBCS)

I - VIII Semesters

CURRICULUM AND SYLLABUS

Vision of the department

- To make every student of the Department irrespective of his/her social, cultural background and learning abilities gets a fair chance in mastering the various fields of Electronics and Instrumentation Engineering to become a proficient individual for the empowerment of society

Mission of the department

The Department strives:

- Professional: To prepare students to understand recent technologies in Electronics and Instrumentation Engineering effectively and adapt themselves in an ever-changing environment.
- Technical Proficiency: To impart excellent computing knowledge to students by providing well equipped facilities and state of the art systems.
- Social Competency: To prepare students with excellent leadership skills, management capabilities and ethical understanding for successful career.

Program Education Objectives (PEOs)

PEO 1 To prepare the students have successful career in industry and motivate for higher education.

PEO 2 To provide strong foundation in basic science and mathematics necessary to formulate, solve and analyse Electronics and Instrumentation problems.

PEO 3 To provide strong foundation in circuit theory, control theory and signal processing concepts and to provide good knowledge of Instrumentation systems and their applications.

PEO 4 To provide knowledge on basic electronics and their applications in Instrumentation engineering and provide an opportunity to work in interdisciplinary groups.

PEO 5 To promote student awareness for lifelong learning and inculcate professional ethics by providing necessary foundation on computational platforms and software applications related to the respective field of Engineering.

Program Specific Outcomes (PSOs)

Our Graduate will be able to:

PSO1: Relate the rudiments of mathematics, science and engineering knowledge to classify, formulate, plan and explore compound engineering problems of electric circuits, analog and digital electronic circuits, process control and instrumentation field along with computational skills.

PSO2: Relate and apply suitable techniques for designing engineering hardware and software tools to assist in design, implement & evaluate the control, measurement, process and instrumentation systems to engross for a life- long learning and thereby work effectually as an distinct individual and also in a multidisciplinary team.

PSO3: Comprehend the influence of Professional performance and ethics, communicate commendably with Electronics and Instrumentation Engineering community and establish a better environment for the society with continual growth.

Program Outcomes (POs):

a) **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b) **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d) **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e) **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f) **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

g) **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

h) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i) Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j) Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

k) Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

l) Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PEO / PO Mapping

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
I	✓	✓	✓	✓	✓	✓		✓	✓		✓	
II						✓	✓	✓	✓	✓	✓	
III	✓	✓	✓	✓	✓					✓	✓	✓
IV	✓	✓	✓	✓					✓	✓	✓	
V	✓		✓			✓	✓	✓		✓	✓	

PO / UNDER GRADUATE SUBJECTS MAPPING

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
SEM I	**THEORY**												
	Communicative English									✓	✓		✓
	Engineering Mathematics- I	✓	✓			✓							✓
	Engineering Physics	✓	✓	✓		✓		✓					✓
	Engineering Chemistry	✓	✓	✓		✓							✓
	Engineering Graphics			✓	✓								
	Problem solving and Python Programming	✓	✓	✓	✓	✓							
	PRACTICALS												
	Python Programming Laboratory	✓		✓	✓	✓	✓				✓		✓
	Physics and Chemistry Laboratory	✓	✓										
SEM II	**THEORY**												
	Professional English									✓	✓		✓
	Engineering Mathematics – II	✓	✓	✓		✓							✓
	Physics for Electronics	✓	✓	✓		✓		✓					✓

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
	Engineering												
	Environmental Science and Engineering	✓	✓			✓	✓	✓	✓				✓
	Basic Civil and Mechanical Engineering				✓		✓						
	Principles of Electrical, Electronics and Communication Engineering	✓	✓	✓	✓	✓							✓
	PRACTICALS												
	Engineering Practices Laboratory	✓		✓	✓	✓	✓				✓		
	Principles of Electrical and Electronic devices Laboratory	✓	✓	✓	✓	✓							✓
SEM III	**THEORY**												
	Transform and Partial Differential Equations	✓	✓			✓							✓
	Electrical and Electronic Measurements	✓	✓	✓	✓	✓					✓		✓
	Transducer Engineering	✓	✓	✓	✓	✓							✓
	Electric Circuit Analysis	✓	✓	✓	✓	✓							✓
	Analog Electronics	✓	✓	✓	✓	✓							✓
	Digital Logic Circuits				✓	✓							
	PRACTICALS												
	Electrical and Electronics measurement Laboratory	✓	✓	✓	✓	✓							✓
	Analog and Digital Electronics Laboratory	✓			✓	✓						✓	✓
	Technical Seminar									✓	✓	✓	
SEM IV	**THEORY**												
	Statistics & Numerical Methods	✓	✓	✓									✓
	Industrial Instrumentation-I	✓	✓	✓	✓	✓					✓		
	Electrical Machines	✓	✓	✓	✓	✓		✓					✓
	Control Systems	✓	✓	✓	✓	✓							✓
	Fundamentals of Data Structures in C (Lab Integrated)			✓	✓	✓							✓
	Communication Engineering			✓	✓	✓							✓
	PRACTICALS												
	Machines and Control Laboratory	✓			✓	✓						✓	✓
	Measurements and Transducers Laboratory			✓	✓	✓	✓			✓	✓		
	Professional Skills Lab									✓	✓	✓	
SEM V	**THEORY**												
	Power Electronics	✓	✓	✓	✓	✓		✓					✓
	Microprocessors and Microcontrollers	✓	✓	✓	✓	✓		✓					
	Biomedical Instrumentation	✓		✓		✓			✓	✓		✓	✓
	Industrial Instrumentation-II	✓	✓	✓	✓	✓		✓					✓
	Open Elective-I	✓		✓	✓						✓	✓	✓
	Professional Elective- I												

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
	Audit course												
	PRACTICALS												
	Microprocessors and Microcontrollers Laboratory	✓		✓	✓						✓	✓	✓
	Industrial Instrumentation Laboratory	✓		✓	✓						✓	✓	✓
SEM VI	**THEORY**												
	Industrial Internet of Things	✓	✓	✓	✓	✓		✓					✓
	Process Control	✓	✓	✓	✓	✓		✓					✓
	Digital Signal Processing	✓	✓	✓	✓	✓		✓					✓
	Embedded Systems (Integrated Lab)	✓		✓		✓			✓	✓		✓	✓
	Object Oriented Programming Systems (Integrated Lab)			✓	✓	✓							✓
	Professional Elective II												
	PRACTICALS												
	Instrumentation System Design Lab	✓		✓	✓						✓	✓	✓
	Process Control Laboratory	✓		✓	✓						✓	✓	✓
SEM VII	**THEORY**												
	Computer Control of Processes	✓	✓	✓	✓	✓		✓					
	Applied Soft Computing	✓	✓	✓	✓	✓		✓					✓
	Industrial Data Network	✓		✓		✓	✓					✓	✓
	Professional Elective- III	✓	✓	✓	✓	✓		✓					✓
	Professional Elective- IV												
	Open Elective – II												
	PRACTICALS												
	Industrial Automation Laboratory	✓		✓	✓						✓	✓	✓
	Project Work- Phase I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SEM VIII	**THEORY**												
	Professional Elective- V												
	Professional Elective- VI												
	PRACTICALS												
	Project Phase II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

PROFESSIONAL ELECTIVES

SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES											
		a	b	c	d	e	f	g	h	i	j	k	l
ELECTIVE I	Computer Networks	✓		✓	✓	✓		✓					
	MEMS and NEMS	✓		✓	✓	✓		✓					
	Electric and Hybrid Vehicles	✓	✓		✓	✓							
	Analytical Instrumentation												
	Modern Control Theory								✓		✓		✓
	Instrumentation Standards			✓	✓	✓	✓						
ELECTIVE II	Process Data Analytics	✓		✓	✓	✓			✓				
	System Identification and Adaptive Control	✓		✓	✓	✓			✓				✓
	Advanced Instrumentation Systems	✓		✓	✓	✓			✓				✓
	Microcontroller Based System Design				✓	✓							
	Digital Image Processing	✓		✓	✓	✓			✓				✓
	Fibre Optics and Laser Instrumentation	✓		✓		✓							
ELECTIVE III	Optimal Control	✓	✓	✓	✓	✓		✓					✓
	Logic and Distributed Control System		✓		✓	✓							
	Advanced Topics in PID Control	✓		✓		✓							
	Model Predictive Control	✓		✓		✓							
	Fault Detection and Diagnosis	✓	✓	✓			✓	✓					
	Safety Instrumented System		✓	✓					✓	✓			
ELECTIVE IV	Advanced Digital Signal Processing	✓	✓	✓	✓	✓		✓					✓
	Radar and Navigational Aids	✓	✓	✓		✓					✓		✓
	CMOS VLSI Design												
	Thermal Power Plant Instrumentation												
	Mechatronics System Design	✓		✓		✓							
	Advanced Process Control	✓	✓		✓			✓				✓	✓
ELECTIVE V	Intellectual Property Rights		✓			✓	✓	✓	✓	✓	✓		
	Professional Ethics in Engineering	✓	✓	✓					✓	✓			✓
	Principles of Management	✓	✓	✓					✓	✓			✓
	Disaster Management	✓	✓	✓					✓	✓			✓
	Principles of Operations Research					✓	✓			✓			
	Human Rights	✓	✓	✓					✓	✓			✓
ELECTIVE VI	Fundamentals of Nano Science	✓	✓	✓					✓	✓			✓
	Non-Linear Control Systems	✓	✓	✓					✓	✓			✓
	Unit Operation and Control	✓		✓	✓	✓	✓						
	Cyber Security for Industrial Automation	✓	✓	✓					✓	✓			✓
	Robotics and Automation	✓	✓	✓					✓	✓			✓
	Instrumentation in Petrochemical Industries	✓		✓		✓							

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING
REGULATIONS – 2021
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.	HS1101	Communicative English	HSC	3	3	0	0	3
2.	MA1102	Engineering Mathematics I	BSC	4	4	0	0	4
3.	PH1103	Engineering Physics	BSC	3	3	0	0	3
4.	CY1104	Engineering Chemistry	BSC	3	3	0	0	3
5.	GE1105	Problem solving and Python Programming	ESC	3	3	0	0	3
6.	GE1106	Engineering Graphics	ESC	6	2	0	4	4
PRACTICALS								
7.	GE1107	Python Programming Laboratory	ESC	4	0	0	4	2
8.	BS1108	Physics and Chemistry Laboratory	BSC	4	0	0	4	2
TOTAL				**30**	**18**	**0**	**12**	**24**
Induction Training			MAC	2 Weeks				

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS1201	Professional English	HSC	3	3	0	0	3
2.	MA1202	Engineering Mathematics – II	BSC	4	4	0	0	4
3.	PH1253	Physics for Electronics Engineering	BSC	3	3	0	0	3
4.	GE1204	Environmental Science and Engineering	HSC	3	3	0	0	3
5.	GE1205	Basic Civil and Mechanical Engineering	ESC	3	3	0	0	3
6.	EE1271	Principles of Electrical, Electronics and Communication Engineering	PCC	3	3	0	0	3
PRACTICALS								
7.	GE1207	Engineering Practices Laboratory	ESC	4	0	0	4	2
8.	EE1278	Principles of Electrical and Electronic devices Laboratory	PCC	4	0	0	4	2
TOTAL				**27**	**19**	**0**	**8**	**23**
Personality & Character Development			**MAC**	**1 Week**				

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1301	Transform and Partial Differential Equations	BSC	4	4	0	0	4
2.	EI1301	Electrical and Electronic Measurements	PCC	4	3	0	0	3
3.	EI1302	Transducer Engineering	PCC	4	3	0	0	3
4.	EE1371	Electric Circuit Analysis	PCC	3	2	1	0	3
5.	EE1372	Analog Electronics	PCC	3	3	0	0	3
6.	EE1373	Digital Logic Circuits	PCC	3	2	1	0	3
PRACTICALS								
7.	EE1391	Analog and Digital Electronics Laboratory	PCC	4	0	0	4	2
8.	EI1308	Electrical and Electronics Measurement Laboratory	PCC	4	0	0	4	2
TOTAL				**29**	**17**	**2**	**8**	**23**
Career Competency Development I- BEC Training				**1 Week**				

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA1401	Statistics & Numerical Methods	BSC	4	3	1	0	4
2.	EI1401	Industrial Instrumentation-I	PCC	4	3	0	0	3
3.	EE1451	Electrical Machines	PCC	3	3	0	0	3
4.	EI1402	Communication Engineering	ESC	3	3	0	0	3
5.	EE1471	Control Systems	PCC	3	2	1	0	3
6.	CS1406	Fundamentals of Data Structures in C (Integrated Lab)	ESC	5	3	0	2	4
PRACTICALS								
7.	EI1408	Machines and Control Laboratory	**ESC**	4	0	0	4	2
8.	EI1409	Measurements and Transducers Laboratory	PCC	4	0	0	4	2
9.	HS1310	Professional Skills Lab	HSC	2	0	0	2	1
TOTAL				**34**	**18**	**2**	**12**	**25**

SEMESTER V

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EE1571	Power Electronics	PCC	3	3	0	0	3

2.	EE1572	Microprocessors and Microcontrollers	PCC	3	3	0	0	3
3.	EI1501	Biomedical Instrumentation	PCC	3	3	0	0	3
4.	EI1502	Industrial Instrumentation-II	PCC	3	3	0	0	3
5.		Open Elective-I	OEC	3	3	0	0	3
6.		Professional Elective- I	PEC	3	3	0	0	3
7.		Audit course *(one from the list of audit courses)	AC	2	2	0	0	0
PRACTICALS								
8.	EE1591	Microprocessors and Microcontrollers Laboratory	PCC	4	0	0	4	2
9.	EI1507	Industrial Instrumentation Laboratory	PCC	4	0	0	4	2
TOTAL				**28**	**20**	**0**	**8**	**22**
Career Competency Development II-(Aptitude and Technical Training)				**1 Week**				
Value Added Course (EEC)				**1 Week 2 Credits**				

SEMESTER VI

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI1601	Industrial Internet of Things	PCC	3	3	0	0	3
2.	EI1602	Process Control	PCC	4	3	0	0	3
3.	EE1671	Digital Signal Processing	PCC	3	2	1	0	3
4.	EE1672	Embedded Systems (Integrated Lab)	ESC	5	3	0	2	4
5.	DS1302	Object Oriented Programming (Integrated Lab)	ESC	5	3	0	2	4
6.	EI1603	Professional Elective II	PCC	3	3	0	0	3
PRACTICALS								
7.	EI1608	Instrumentation System Design Lab	PCC	4	0	0	4	2
8.	EI1609	Process Control Laboratory	PCC	4	0	0	4	2
TOTAL				**29**	**17**	**1**	**12**	**24**
Career Competency Development III (Aptitude & Technical Training)				4 Weeks				
Internship -I				2 weeks - 1 credit				

SEMESTER VII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI1701	Computer Control of Processes	PCC	3	3	0	0	3
2.	EI1702	Applied Soft Computing	PCC	3	3	0	0	3
3.	EI1703	Industrial Data Network	PCC	3	3	0	0	3
4.		Professional Elective- III	PEC	3	3	0	0	3
5.		Professional Elective- IV	PEC	3	3	0	0	3

6.		Open Elective – II	OEC	3	3	0	0	3
PRACTICALS								
7.	EI1708	Industrial Automation Laboratory	PCC	4	0	0	4	2
8.	EI1709	Project Work- Phase I	EEC	4	0	0	4	2
TOTAL				**26**	**18**	**0**	**8**	**22**
Career Competency Development V (Company specific Training)				1 Week				

SEMESTER VIII

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective- V	PEC	3	3	0	0	3
2.		Professional Elective- VI	PEC	3	3	0	0	3
PRACTICALS								
3.	EI1801	Project Phase II	EEC	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

TOTAL CREDITS= 179

PROFESSIONAL ELECTIVE – I (V SEMESTER)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CS1404	Computer Networks	PE	3	3	0	0	3
2.	EC1008	MEMS and NEMS	PE	3	3	0	0	3
3.	EE1552	Electric and Hybrid Vehicles	PE	3	3	0	0	3
4.	EI1511	Analytical Instrumentation	PE	3	3	0	0	3
5.	EI1512	Modern Control Theory	PE	3	3	0	0	3
6.	EI1513	Instrumentation Standards	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – II (VI SEMESTER)

S. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI1621	Process Data Analytics	PE	3	3	0	0	3
2.	EE1731	System Identification and Adaptive Control	PE	3	3	0	0	3
3.	EI1622	Advanced Instrumentation Systems	PE	3	3	0	0	3
4.	EE1853	Microcontroller Based System Design	PE	3	3	0	0	3
5.	EI1623	Digital Image Processing	PE	3	3	0	0	3
6.	EI1624	Fibre Optics and Laser Instrumentation	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – III (VII SEMESTER)

S. NO.	COURSECODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI1731	Optimal Control	PE	3	3	0	0	3
2.	EI1732	Logic and Distributed Control System	PE	3	3	0	0	3
3.	EI1733	Advanced Topics in PID Control	PE	3	3	0	0	3
4.	EI1734	Model Predictive Control	PE	3	3	0	0	3
5.	EI1735	Fault Detection and Diagnosis	PE	3	3	0	0	3
6.	EI1736	Safety Instrumental System	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EC1007	Advanced Digital Signal Processing	PE	3	3	0	0	3
2.	EC1702	Radar and Navigational Aids	PE	3	3	0	0	3
3.	EC1731	CMOS VLSI Design	PE	3	3	0	0	3
4.	EI1741	Thermal Power Plant Instrumentation	PE	3	3	0	0	3
5.	EI1742	Mechatronics System Design	PE	3	3	0	0	3
6.	EI1743	Advanced Process Control	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE1001	Intellectual Property Rights	PE	3	3	0	0	3
2.	GE1003	Professional Ethics in Engineering	PE	3	3	0	0	3
3.	MG1001	Principles of Management	PE	3	3	0	0	3
4.	CE1025	Disaster Management	PE	3	3	0	0	3
5.	MG1002	Operational Research	PE	3	3	0	0	3
6.	GE1002	Human Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – VI (VIIISEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE1004	Fundamentals of Nano Science	PE	3	3	0	0	3
2.	EI1861	Non-Linear Control Systems	PE	3	3	0	0	3
3.	EI1862	Unit Operation and Control	PE	3	3	0	0	3

4.	EI1863	Cyber Security for Industrial Automation	PE	3	3	0	0	3
5.	EI1864	Robotics and Automation	PE	3	3	0	0	3
6.	EI1865	Instrumentation in Petrochemical Industries	PE	3	3	0	0	3

OPEN ELECTIVE -I (VI SEMESTER)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCS103	Introduction to Cloud Computing	OE	3	3	0	0	3
2.	OCS104	Database Management Systems	OE	3	3	0	0	3
3.	OME106	Testing of Materials	OE	3	3	0	0	3
4.	OBT104	Biosensors	OE	3	3	0	0	3
5.	OEE107	Solar and Wind Energy systems	OE	3	3	0	0	3
6.	OME104	Industrial Safety Engineering	OE	3	3	0	0	3
7.	OCE101	Air Pollution and Control	OE	3	3	0	0	3

OPEN ELECTIVE -II (VII SEMESTER)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	OCS105	Data Analytics with R Programming	OE	3	3	0	0	3
2.	OME102	Design of Experiments	OE	3	3	0	0	3
3.	OME105	Product Design and Development	OE	3	3	0	0	3
4.	OME107	Vibration and Noise Control	OE	3	3	0	0	3
5.	OEC101	Introduction to Signals and Systems	OE	3	3	0	0	3
6.	OCH102	Process Modelling and Simulation	OE	3	3	0	0	3
7.	OMB101	Total Quality Management	OE	3	3	0	0	3

AUDIT COURSE

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	AD1001	Constitution of India	AC	3	2	0	0	0
2.	AD1002	Value Education	AC	3	2	0	0	0
3.	AD1003	Pedagogy Studies	AC	3	2	0	0	0
4.	AD1004	Stress Management by Yoga	AC	3	2	0	0	0
5.	AD1005	Personality Development Through Life Enlightenment Skills	AC	3	2	0	0	0
6.	AD1006	Unnati Bharat Abhiyan	AC	3	2	0	0	0
7.	AD1007	Essence of Indian Knowledge Tradition	AC	3	2	0	0	0
8.	AD1008	Sanga Tamil Literature Appreciation	AC	3	2	0	0	0

SEMESTER I

HS1101	COMMUNICATIVE ENGLISH	L	T	P	C
	(Common for all Branches of B.E. / B. Tech Programmes)	3	0	0	3

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	9

Reading – critical reading – finding key information in a given text – shifting facts from opinions - Writing - autobiographical writing - developing hints. Listening- short texts- short formal and informal conversations. Speaking- basics in speaking - introducing oneself - exchanging personal information- speaking on given topics & situations Language development– voices- Wh-Questions- asking and answering-yes or no questions– parts of speech. Vocabulary development--prefixes- suffixes- articles - Polite Expressions.

UNIT II	GENERAL READING AND FREE WRITING	9

Reading: Short narratives and descriptions from newspapers (including dialogues and conversations ; Reading Comprehension Texts with varied question types - Writing – paragraph writing- topic sentence- main ideas- free writing, short narrative descriptions using some suggested vocabulary and structures –. Listening - long texts - TED talks - extensive speech on current affairs and discussions Speaking – describing a simple process – asking and answering questions - Language development – prepositions, clauses. Vocabulary development- guessing meanings of words in context – use of sequence words.

UNIT III	GRAMMAR AND LANGUAGE DEVELOPMENT	9

Reading- short texts and longer passages (close reading) & making a critical analysis of the given text Writing – types of paragraph and writing essays – rearrangement of jumbled sentences. Listening: Listening to ted talks and long speeches for comprehension. Speaking- role plays - asking about routine actions and expressing opinions. Language development- degrees of comparison-pronouns- Direct vs. Indirect Questions. Vocabulary development – idioms and phrases- cause & effect expressions, adverbs.

UNIT IV	READING AND LANGUAGE DEVELOPMENT	9

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 comprehension (IELTS, TOEFL and others). Speaking -Speaking about friends/places/hobbies - Language development- Tenses- simple present-simple past- present continuous and past continuous-

conditionals – if, unless, in case, when and others Vocabulary development- synonyms-antonyms-Single word substitutes- Collocations.

UNIT V	EXTENDED WRITING	9

Reading: Reading for comparisons and contrast and other deeper levels of meaning –Writing-brainstorming -writing short essays – developing an outline- identifying main and subordinate ideas-dialogue writing- Listening - popular speeches and presentations - Speaking - impromptu speeches & debates Language development-modal verbs- present/ past perfect tense - Vocabulary development-Phrasal verbs- fixed and semi-fixed expressions.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Board of Editors. Using English A Course book for Undergraduate Engineers and Technologists. Orient Black Swan Limited, Hyderabad: 2020
2. Sanjay Kumar & Pushp Lata Communication Skills Second Edition, Oxford University Press: 2015.
3. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCE BOOKS

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge,2011.
2. Means, L. Thomas and Elaine Langlois. English & Communication For Colleges. Cengage Learning ,USA: 2007
3. Redston, Chris &Gillies Cunningham Face 2 Face (Pre-intermediate Student's Book& Workbook) Cambridge University Press, New Delhi: 2005
4. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
5. Dutt P. Kiranmai and Rajeevan Geeta Basic Communication Skills, Foundation Books: 2013
6. John Eastwood et al : Be Grammar Ready: The Ultimate Guide to English Grammar, Oxford University Press: 2020. .

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents

CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	J	k	l	1	2	3
CO1	0	0	0	0	0	0	0	0	2	3	0	0	0	0	3
CO2	0	1	0	2	0	0	0	0	0	3	0	0	0	0	0
CO3	0	2	0	3	0	0	0	0	0	2	0	0	3	0	1
CO4	0	0	0	0	0	0	0	0	2	2	0	0	1	0	2
C05	0	2	1	1	2	0	2	0	0	3	0	0	1	0	1

MA1102	ENGINEERING MATHEMATICS –I	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	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 modeling the engineering problems mathematically and obtaining solutions.
- Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering.
- This is a foundation course of Single Variable and multivariable calculus plays an important role in the understanding of science, engineering, economics and computer science, among other 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	CALCULUS OF ONE VARIABLE	12

Limit of a function - Continuity - Derivatives - Differentiation rules – Interval of increasing and decreasing functions – Maxima and Minima - Intervals of concavity and convexity.

UNIT III	CALCULUS 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 IV	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 V	**MULTIPLE INTEGRALS**	**12**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Change of variables from Cartesian to polar in double integrals-Triple integrals – Volume of solids.		
		TOTAL : 60 PERIODS

TEXT BOOKS

1. Grewal B.S., Higher Engineering Mathematics‖, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. James Stewart, "Calculus: Early Transcendental", Cengage Learning, 7th Edition, New Delhi,2015. [For Units I & III - Sections 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, 7.2 - 7.4 and 7.8].

REFERENCE BOOKS

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.T. Veerarajan. Engineering Mathematics – I, McGraw Hill Education; First edition 2017.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Have a clear idea of matrix algebra pertaining Eigenvalues and Eigenvectors in addition dealing with quadratic forms.
CO2	Understand the concept of limit of a function and apply the same to deal with continuity and derivative of a given function. Apply differentiation to solve maxima and minima problems, which are related to real world problems.
CO3	Have the idea of extension of a function of one variable to several variables. Multivariable functions of real variables are inevitable in engineering.
CO4	Understand the concept of integration through fundamental theorem of calculus. Also acquire

	skills to evaluate the integrals using the techniques of substitution, partial fraction and integration by parts along with the knowledge of improper integrals.
CO5	Do double and triple integration so that they can handle integrals of higher order which are applied in engineering field.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	1	2	3	0	0	3	2	3	3	2	2	1
CO2	3	3	3	2	2	1	0	0	0	0	1	2	2	2	1
CO3	3	3	3	2	2	1	0	0	0	0	1	2	2	1	1
CO4	3	3	3	2	2	1	0	0	0	0	1	2	2	1	1
C05	3	3	3	2	1	1	0	0	0	0	1	2	2	1	1

PH1103	ENGINEERING PHYSICS	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To make the students to understand about the elastic property and stress strain diagram.
- To educate the students about principle of laser and its role in optical fibers and its applications as sensors and communication.
- To teach the students about the heat transfer through solids and liquids.
- To educate the students about the quantum concepts and its use to explain black body radiation, Compton effect, tunnelling electron microscopy and its applications.
- To make the students to understand the importance of various crystal structures and various growth techniques.

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 – Practical applications of modulus of elasticity-I-shaped girders - stress due to bending in beams.

UNIT II	LASER AND FIBER OPTICS	9

Lasers : population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG Laser-Semiconductor lasers: homojunction and heterojunction – Industrial and medical applications of Laser– Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, mode) – losses associated with optical fibers – Fabrication of Optical fiber-Double crucible method-fibre optic sensors: pressure and displacement-Industrial and medical applications of optical fiber- Endoscopy-Fiber optic communication system.

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 – Rectilinear flow of heat- Lee's disc method: theory and experiment - conduction through compound media (series and parallel)-Radial flow of heat– thermal insulation – applications: heat exchangers, refrigerators, oven, Induction furnace 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 – Electron microscope-tunnelling (qualitative) - scanning tunnelling microscope-Applications of electron microscopy.

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 – Graphite structure-crystal imperfections: point defects, line defects – Burger vectors, stacking faults – growth of single crystals: solution and melt growth techniques-Epitaxial growth-Applications of Single crystal (Qualitative).

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2019.
2. Gaur, R.K. & Gupta, S.L. "Engineering Physics". Dhanpat Rai Publishers, 2017.
3. Pandey, B.K. & Chaturvedi, S. "Engineering Physics". Cengage Learning India, 2019.

REFERENCE BOOKS

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, 2019.
3. Tipler, P.A. & Mosca, G. "Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Gain knowledge on the basics of properties of matter and its applications,
CO2	Acquire knowledge on the concepts of waves and optical devices and their applications in fibre optics.
CO3	Have adequate knowledge on the concepts of thermal properties of materials and their applications in expansion joints and heat exchangers.
CO4	Get knowledge on advanced physics concepts of quantum theory and its applications in tunneling microscopes, and
CO5	Understand the basics of crystals, their structures and different crystal growth techniques.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	3	2	2	1	3	2	1	2	3	2	2
CO2	3	3	3	2	3	2	2	1	2	2	2	1	2	2	3
CO3	3	3	2	2	2	1	2	1	2	1	1	2	2	2	2
CO4	3	3	2	2	2	1	1	1	1	1	1	3	3	3	3
C05	3	3	3	3	2	1	2	1	3	1	1	3	3	3	3

CY1104	ENGINEERING CHEMISTRY	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- Principles of water characterization and treatment for industrial purposes.
- Principles and applications of surface chemistry and catalysis.
- Phase rule and various types of alloys.
- Various types of fuels, applications and combustion.
- Conventional and non–conventional energy sources and energy storage device.

UNIT I	WATER AND ITS TREATMENT	9

Hardness of water – Types – Expression of hardness – Units – Estimation of hardness by EDTA method – Numerical problems on EDTA method – Boiler troubles (scale and sludge, caustic embrittlement , boiler corrosion, priming and foaming) – Treatment of boiler feed water – Internal treatment (carbonate, phosphate, colloidal, sodium aluminate and calgon conditioning) – External treatment – Ion exchange process, Zeolite process – Desalination of brackish water by reverse Osmosis.

UNIT II	SURFACE CHEMISTRY AND CATALYSIS	9

Surface chemistry: Types of adsorption – Adsorption of gases on solids – Adsorption of solute from solutions – Adsorption isotherms – Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Kinetics of uni-molecular surface reactions – Adsorption in chromatography – Applications of

adsorption in pollution abatement using PAC.

Catalysis: Catalyst – Types of catalysis – Criteria – Contact theory – Catalytic poisoning and catalytic promoters – Industrial applications of catalysts – Catalytic convertor – Auto catalysis – Enzyme catalysis – Michaelis-Menten equation.

UNIT III	**PHASE RULE AND ALLOYS**	**9**

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.

Alloys: Introduction – Definition – Properties of alloys – Significance of alloying – Functions and effect of alloying elements – Nichrome, Alnico, Stainless steel (18/8) – Heat treatment of steel – Non-ferrous alloys – Brass and bronze.

UNIT IV	**FUELS AND COMBUSTION**	**9**

Fuels: Introduction – classification of fuels – Comparison of solid, liquid, gaseous fuels – Coal – Analysis of coal (proximate and ultimate). – Carbonization – Manufacture of metallurgical coke (Otto Hoffmann method) – Petroleum – Cracking – Manufacture of synthetic petrol (Bergius process, Fischer Tropsch Process) – Knocking – Octane number – Diesel oil – Cetane number – 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 by Orsat Method.

UNIT V	**NON–CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES**	**9**

Nuclear energy – Fission and fusion reactions – Differences – Chain reactions – Nuclear reactors – Classification of reactors – Light water nuclear reactor for power generation – Breeder reactor – Solar energy conversion – Solar cells – Wind energy – Fuel cells – Hydrogen-oxygen fuel cell . Batteries – Types of batteries - Alkaline batteries – Lead-acid, Nickel-cadmium and Lithium batteries.

TOTAL : 45 PERIODS

TEXT BOOKS

1.P.C.Jain, Monica Jain, "Engineering Chemistry" 17th Ed. Dhanpat Rai Pub. Co., New Delhi,(2015).

2.S.S. Dara, S.S. Umare, "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2020).

3.S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India (P) Ltd. New Delhi, (2018).

4.P. Kannan, A. Ravikrishnan, "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company (P) Ltd. Chennai, (2009).

REFERENCE BOOKS

1.B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).

2.B. Sivasankar "Engineering Chemistry" Tata McGraw–Hill Pub.Co.Ltd, New Delhi (2008).

3.Prasanta Rath, "Engineering Chemistry", Cengage Learning India (P) Ltd., Delhi, (2015).

4.Shikha Agarwal, "Engineering Chemistry–Fundamentals and Applications", Cambridge University Press, Delhi, (2015).

5.A. Pahari, B. Chauhan, "Engineering Chemistry", Firewall Media. New Delhi. (2010).

6.Sheik Mideen., Engineering Chemistry, Airwalk Publications, Chennai (2018).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Able to understand impurities in industrial water, boiler troubles, internal and external treatment methods of purifying water.
CO2	Able to understand concepts of absorption, adsorption, adsorption isotherms, application of adsorption for pollution abatement, catalysis and enzyme kinetics.
CO3	Able to recognize significance of alloying, functions of alloying elements and types of alloys, uses of alloys. They should be acquainted with phase rule and reduced phase and its applications in alloying.
CO4	Able to identify various types of fuels, properties, uses and analysis of fuels. They should be able to understand combustion of fuels, method of preparation of bio-diesel, synthetic petrol.
CO5	Able to understand conventional, non–conventional energy sources, nuclear fission and fusion, power generation by nuclear reactor, wind, solar energy and preparation, uses of various batteries.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	3	2	3	2	2	2	2	2	2	2	2
CO2	3	3	2	2	2	2	2	1	1	1	1	2	1	1	1
CO3	3	3	3	3	3	2	2	1	2	2	2	2	2	2	2
CO4	3	3	3	2	2	3	3	2	2	3	2	2	1	2	2
C05	3	2	3	3	3	3	3	2	2	2	2	2	3	3	2

GE1105	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To know the basics of algorithmic problem solving
- To write simple python programs
- To develop python program by using control structures and functions
- To use python predefined data structures
- To write file-based program

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: Basic algorithms, flowcharts and pseudocode for sequential, decision processing and iterative processing strategies, 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	**INTRODUCTION TO PYTHON**	**9**
Python Introduction, Technical Strength of Python, Python interpreter and interactive mode, Introduction to colab , pycharm and jupyter idle(s) ,Values and types: int, float, boolean, string, and list; Built-in data types, variables, Literals, Constants, statements, Operators: Assignment, Arithmetic, Relational, Logical, Bitwise operators and their precedence, Expressions, tuple assignment, Accepting input from Console, printing statements, Simple Python programs.		
UNIT III	**CONTROL FLOW, FUNCTIONS AND STRINGS**	**9**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: while, for; Loop manipulation using pass, break, continue, and else; Modules and Functions: function definition and use, flow of execution, parameters and arguments, local and global scope, return values, function composition, recursion. Strings: string slices, immutability, string functions and methods, string module; Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		
UNIT IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: Defining list and list slicing, list operations, list slices, list methods, list loop, list Manipulation, mutability, aliasing, cloning lists, list parameters, lists as arrays. Tuples: tuple assignment, tuple as return value, tuple Manipulation; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.		
UNIT V	**FILES, MODULES, PACKAGES**	**9**
Files and exception: Concept of Files, Text Files; File opening in various modes and closing of a file, Format Operators, Reading from a file, Writing onto a file, File functions- open(), close(), read(),readline(), readlines(),write(), writelines(),tell(),seek(), Command Line arguments; Errors and exceptions: handling exceptions; modules, packages; introduction to numpy, matplotlib. Illustrative programs: word count, copy a file.		
	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/thinkpython/) 2.Guido van Rossum and Fred L. Drake Jr, ― An Introduction to Python – Revised and		

updated for Python 3.2, Network Theory Ltd., 2011.

3.Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019.

REFERENCE BOOKS

1.John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013

2.Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

3.Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

4.Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.

5.Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

6.Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Develop algorithmic solutions to simple computational problems
CO2	Develop simple console application in python
CO3	Develop python program by applying control structure and decompose program into functions.
CO4	Represent compound data using python lists, tuples, and dictionaries.
CO5	Read and write data from/to files in Python.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO2	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO3	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO4	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO5	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2

GE1106	**ENGINEERING GRAPHICS**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. / B. Tech Programmes)	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**	**6+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		

TEXT BOOKS

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, Twenty Ninth Edition 2016
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2011.

REFERENCE BOOKS

1.Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2019.

2.Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

3.Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2018.

4.Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Comput er 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.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and standards of Engineering graphics
CO2	Perform freehand sketching of basic geometrical constructions and multiple views of objects
CO3	Understand the concept of orthographic projections of lines and plane surfaces
CO4	Draw the projections of section of solids and development of surfaces
CO5	Visualize and to project isometric and perspective sections of simple solids

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	2	1	2	1	1	0	0	3	3	2	3	1	1	0
CO2	3	1	2	2	1	1	0	0	3	3	2	3	1	1	0
CO3	3	1	1	3	1	1	0	0	3	3	2	3	1	1	0
CO4	3	1	1	3	1	1	0	0	3	3	2	3	1	1	0
CO5	3	1	2	3	1	1	0	0	3	3	2	3	1	1	0

GE1107	**PYTHON PROGRAMMING LABORATORY**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. / B. Tech Programmes)	0	0	4	2

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, and dictionaries.

•Read and write data from/to files in Python.
LIST OF EXPERIMENTS
1.Write an algorithm and draw flowchart illustrating mail merge concept.
2.Write an algorithm, draw flowchart and write pseudo code for a real life or scientific or technical problems
3.Scientific problem-solving using decision making and looping. Armstrong number, palindrome of a number, Perfect number.
4.Simple programming for one dimensional and two-dimensional arrays. Transpose, addition, multiplication, scalar, determinant of a matrix
5.Program to explore string functions and recursive functions.
6.Utilizing 'Functions' in Python •Find mean, median, mode for the given set of numbers in a list. •Write a function dups to find all duplicates in the list. •Write a function unique to find all the unique elements of a list. •Write function to compute gcd, lcm of two numbers.
7.Demonstrate the use of Dictionaries and tuples with sample programs
8.Implement Searching Operations: Linear and Binary Search.
9.To sort the 'n' numbers using: Selection, Merge sort and Insertion Sort.
10.Find the most frequent words in a text of file using command line arguments.
11.Demonstrate Exceptions in Python.
12.Applications: Implementing GUI using turtle, pygame.
TOTAL: 60 PERIODS
REFERENCE BOOKS
1.Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2019 2.Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016. 3.Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013. 4.David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009. 5.David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013)
WEB REFERENCES
1.http://www.edx.org
COURSE OUTCOMES **Upon completion of the course, students will be able to**

CO1	Develop simple console applications through python with control structure and functions

CO2	Use python built in data structures like lists, tuples, and dictionaries for representing compound data.
CO3	Implement Python programs with conditionals and loops.
CO4	Read and write data from/to files in Python and applications of python.
CO5	Develop Python programs step-wise by defining functions and calling them.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO2	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO3	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO4	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2
CO5	3	3	3	3	2	0	0	0	0	2	2	2	3	3	2

BS1108	**PHYSICS AND CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. /B. Tech Programmes)	0	0	4	2

Objectives

The students will be trained to perform experiments to study the following.

- The Properties of Matter
- The Optical properties, Characteristics of Lasers & Optical Fibre
- Electrical & Thermal properties of Materials
- Enable the students to enhance accuracy in experimental measurements.
- To make the student to acquire practical skills in the determination of water quality parameters through volumetric analysis
- Instrumental method of analysis such as potentiometry, conductometry and pH metry

LIST OF EXPERIMENTS– PHYSICS

A minimum of 5 experiments to be performed from the given list)	
1.Determination of Young's modulus of the material of the given beam by Non-uniform bending method.	**CO1**
2. Determination of rigidity modulus of the material of the given wire using torsion pendulum.	**CO1**
3. Determination of wavelength of mercury spectra using Spectrometer and grating.	
4. Determination of dispersive power of prism using Spectrometer.	

5. (a) Determination of wavelength and particle size using a laser. (b) Determination of numerical aperture and acceptance angle of an optical fibre. (c) Determination of width of the groove of compact disc using laser 6. Determination of Young's modulus of the material of the given beam by uniform bending method. 7. Determination of energy band gap of the semiconductor. 8. Determination of coefficient of thermal conductivity of the given bad conductor using Lee's disc. **DEMONSTRATION EXPERIMENT** Determination of thickness of a thin sheet / wire – Air wedge method	**CO2** **CO2** **CO2** **CO1** **CO2** **CO2** **CO1**
LIST OF EXPERIMENTS – CHEMISTRY	
(A minimum of 6 experiments to be performed from the given list) 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.Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer. 10. Conductometric titration of strong acid vs strong base. **DEMONSTRATION EXPERIMENTS** 1.Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method). 2. Estimation of sodium and potassium present in water using flame photometer.	**CO5** **CO5** **CO5** **CO3** **CO3** **CO3** **CO4** **CO4** **CO4** **CO4** **CO3** **CO5**
TOTAL: 60 PERIODS	

COURSE OUTCOMES **Upon completion of the course, students should be**	
CO1	Able to understand the concept about the basic properties of matter like stress, strain and types of moduli Able to understand the concept of optics like reflection, refraction, diffraction by using spectrometer grating.
CO2	Able to understand the thermal properties of solids, specific heat and some models for specific

	heat calculation. Able to understand the working principle of laser components and working of different laser system. Able to understand the phenomenon of light, applications of fibre optics.
CO3	Able to understand the concept of determining the pH value by using pH meter. Able to understand the concept about the amount of chloride present in the given sample of water.
CO4	Able to understand the concept of determining the emf values by using potentiometer Able to understand the concept about the measurement of conductance of strong acid and strong base by using conductivity meter.
CO5	Able to understand the amount of dissolved oxygen present in the water. Able to understand the concept of estimation of hardness of water by EDTA method. Able to understand the concept of estimation of alkalinity in water sample.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	1	2	2	2	1	1	1	3	2	2	3	2	2	1
CO2	3	1	2	1	1	1	1	1	2	1	1	2	2	1	2
CO3	3	1	2	1	2	2	2	1	2	1	1	1	2	2	1
CO4	3	2	1	1	2	1	1	1	2	1	1	2	2	1	2
CO5	3	2	1	1	1	2	2	1	2	1	2	1	2	2	2

SEMESTER II

HS1201	**PROFESSIONAL ENGLISH**	**L**	**T**	**P**	**C**
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- 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 specialization.

UNIT I	**READING AND STUDY SKILLS**	**9**

Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical

adjectives.		
UNIT II	**READING AND STUDY SKILLS**	**9**
Listening-Listening Comprehension of a discussion on a technical topic of common interest by three or four participants (real life as well as online videos). -Speaking – describing a process- Reading: Practice in chunking and speed reading - Paragraphing- Writing- interpreting charts, graphs- Vocabulary Development: Important foreign expressions in Use, homonyms, homophones, homographs- easily confused words Language Development- impersonal passive voice, numerical adjectives.		
UNIT III	**TECHNICAL WRITING AND GRAMMAR**	**9**
Listening – listening to conversation – effective use of words and their sound aspects, stress, intonation & pronunciation - Speaking – mechanics of presentations -Reading: Reading longer texts for detailed understanding. (GRE/IELTS practice tests); Writing-Describing a process, use of sequence words- Vocabulary Development- sequence words- Informal vocabulary and formal substitutes-Misspelled words. Language Development- embedded sentences and Ellipsis.		
UNIT IV	**REPORT WRITING**	**9**
Listening – Model debates & documentaries and making notes. Speaking – expressing agreement/disagreement, assertiveness in expressing opinions-Reading: Technical reports, advertisements and minutes of meeting - 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**	**9**
Listening: Extensive Listening. (radio plays, rendering of poems, audio books and others) Speaking – participating in a group discussion - Reading: Extensive Reading (short stories, novels, poetry and others)– Writing reports- minutes of a meeting- accident and survey- Writing a letter/ sending an email to the Editor - cause and effect sentences -Vocabulary Development- verbal analogies. Language Development- reported speech.		
		TOTAL : 45 PERIODS
TEXT BOOKS		
1.Board of editors. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2020. 2.Barun K Mitra, Effective Technical Communication Oxford University Press: 2006. 3.Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.		
REFERENCE BOOKS		
1.Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014. 2.Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015 3.Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014. 4.Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007 5.Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning,USA: 2007.		

6.Caroline Meyer & Bringi dev, communicating for Results Oxford University Press: 2021.
7.Aruna Koneru, Professional Speaking Skills, Oxford University Press: 2015.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
CO2	Write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
CO3	Read different genres of texts adopting various reading strategies.
CO4	Listen/view and comprehend different spoken discourses/excerpts in different accents
CO5	Identify topics and formulate questions for productive inquiry

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	0	0	0	0	0	0	0	1	2	3	0	0	0	0	1
CO2	0	1	0	2	0	0	0	0	0	3	0	0	0	1	2
CO3	0	2	0	3	0	0	0	0	1	2	0	0	0	1	2
CO4	0	0	0	0	1	0	0	0	2	2	0	0	0	2	1
C05	0	2	1	1	2	0	2	0	0	3	0	0	3	3	3

MA1202	**ENGINEERING MATHEMATICS - II**	**L**	**T**	**P**	**C**
(Common for all branches of B.E. / B. Tech Programmes Except AI-DS & AI-ML)		4	0	0	4

Objectives

- This course is designed to cover topics such as Differential Equation, Vector Calculus, Complex Analysis and Laplace Transform. 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	**ORDINARY 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.

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	**COMPLEX VARIABLES**	**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, 1/Z - Bilinear transformation.		
UNIT IV	**COMPLEX INTEGRATION**	**12**
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(excluding poles on the real line).		
UNIT V	**LAPLACE TRANSFORMS**	**12**
Existence conditions – Transforms of elementary functions –Basic properties – Transform of unit step function and unit impulse function - Shifting theorems - transforms of derivatives and integrals — Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.		
TOTAL : 60 PERIODS		

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

REFERENCE BOOKS

1.G 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

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Apply various techniques in solving differential equations
CO2	Gradient, divergence and curl of a vector point function and related identities

CO3	Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification
CO4	Analytic functions, conformal mapping and complex integration
CO5	Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	2	1	0	0	0	0	1	2	2	1	1
CO2	3	3	3	1	1	1	0	0	0	0	2	1	2	1	1
CO3	3	3	3	2	1	1	0	1	0	0	1	1	1	1	1
CO4	3	3	3	1	0	0	0	0	0	0	1	0	1	1	1
C05	3	3	3	1	0	0	0	0	0	0	1	0	1	1	1

PH1253	**PHYSICS FOR ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	(Common to EEE, ECE, EIE)	3	0	0	3

Objectives

- Understand the transport properties of conducting materials and their modelling using classical and quantum theories,
- Comprehend the origin of magnetic and superconducting properties in different materials and their engineering applications,
- Grasp the principles of dielectric materials and its applications.
- Understand the key factors for effective design of an optoelectronic device by its energy efficiency, and
- Analyze the structure-property of nano materials and their applications.

UNIT - I	**CONDUCTING 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 theorem – metals and insulators - Energy bands in solids– tight binding approximation - Electron effective mass – concept of hole.

UNIT - II	**PHYSICS OF SEMICONDUCTOR DEVICES**	**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 – Zener diode as voltage regulator- Ohmic contacts – tunnel diode - Schottky diode- MOS Capacitor.

UNIT - III	MAGNETIC AND DIELECTRIC MATERIALS	9

Origin of magnetic moment – Bohr magneton – Microscopic and macroscopic classification of magnetic materials : comparison of diamagnetism , para magnetism and ferro magnetism – Domain theory – Hysteresis (based on domain theory) – soft and hard magnetic materials – Ferrites – applications. Dielectric materials: Polarization processes – dielectric loss – internal field – Clausius-Mosotti relation- dielectric breakdown.

UNIT - IV	OPTICAL 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 – excitons - quantum confined Stark effect – Quantum dot laser, Quantum well laser.

UNIT - V	NANODEVICES	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 – resonant tunneling – quantum interference effects –mesoscopic structures – Coulomb blockade effects- Single electron phenomena and Single electron Transistor – magnetic semiconductors– spintronics, Spintronic Devices : Spin Valve - Spin FET, Carbon nanotubes: Types ,Preparation- CVD, Properties and applications.

TOTAL : 45 PERIODS

TEXT BOOKS

1.Umesh K Mishra & Jasprit Singh, "Semiconductor Device Physics and Design",Springer, 2008

2.Adaptation by Balasubramanian, R, Callister "Material Science and Engineering", Wiley India Pvt. Ltd., 2nd Edition, 2014.

3.Mani.P , "Physics for Electronics Engineering", Dhanam Publishers , 2017.

4.Salivahanan,S., Rajalakshmi,A., Karthie,S., Rajesh,N.P., "Physics for Electronics Engineering and Information Science", McGraw Hill Education (India) Private Limited, 2018.

REFERENCE BOOKS

1.Traugott Fischer , "Materials Science for Engineering Students" ,Ist Edition,Elsevier , 2009

2.Budinski, K.G. & Budinski, M.K. "Engineering Materials Properties and Selection", Prentice Hall, 2009.

3.Rogers, B., Adams, J.& Pennathur, S."Nanotechnology: Understanding Small Systems". CRC Press,2014

4.Hanson, G.W. "Fundamentals of Nanoelectronics". Pearson Education,2009

5.Kwok Ng, Simon Sze, and Yiming Li," Physics of Semiconductor Devices", 2006.

COURSE OUTCOMES	
Upon completion of the course, students will be able to	
CO1	Gain knowledge on classical and quantum free electron theories and formation of energy band structures.
CO2	Gain knowledge on semiconducting devices and its applications.
CO3	Acquire knowledge on magnetic and superconducting materials and their applications.
CO4	Understand the relationship of optoelectronic materials and their applications in various domains.
CO5	Acquire knowledge about the nano structures and its applications

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	2	2	1	2	1	1	1	2	1	3	2	2
CO2	3	3	1	1	3	1	1	1	2	2	2	1	3	3	2
CO3	3	3	1	1	2	2	1	1	1	1	1	2	3	3	2
CO4	3	3	3	2	2	1	1	1	2	2	1	3	3	3	2
C05	3	3	3	2	3	1	1	1	2	1	2	3	3	3	3

GE1204	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
	(Common for all branches of B.E. / B. Tech Programmes)	3	0	0	3

Objectives

- To study the inter relationship 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 find and implement scientific, technological, economic and political solutions to environmental problems.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	9

Definition, scope and importance of environment – Need for public awareness – Role of Individual in Environmental protection – Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food webs and ecological pyramids – Ecological succession – Types, characteristic features, structure and function of

forest, grass land, desert and aquatic (ponds, lakes, rivers, oceans, estuaries) ecosystem. Biodiversity – Definition – Genetic, species and ecosystem diversity – 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 wild life, human-wildlife conflicts – Wildlife protection act and forest conservation act –Endangered and endemic species – Conservation of biodiversity – In-situ and ex–situ conservation of biodiversity.		
UNIT II	**ENVIRONMENTAL POLLUTION**	**9**
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 – Problems of e-waste – Role of an individual in prevention of pollution – Pollution case studies – Disaster management – Floods, earthquake, cyclone, tsunami and landslides – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.		
UNIT III	**NATURAL RESOURCES**	**9**
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 overutilization 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**	**9**
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 – Principles of Green Chemistry – Environment protection 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– National Green Tribunal – Public awareness.		
UNIT V	**HUMAN POPULATION AND THE ENVIRONMENT**	**9**
Population growth – Variation among nations – Population explosion – Family welfare programme –		

Environment and human health – Human rights – Value education – HIV / AIDS – COVID 19 – Women and child welfare – Role of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

TEXT BOOKS

1.Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2014).
2.Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, (2004).
3.Dr. A. Sheik Mideen and S.Izzat Fathima, "Environmental Science and Engineering", Airwalk Publications, Chennai, (2018).

REFERENCE BOOKS

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,Scott E. Spoolman, "Environmental Science", Cengage Learning India Pvt. Ltd, Delhi, (2014).
4.R. Rajagopalan, 'Environmental Studies-From Crisis to Cure', Oxford University Press, (2005).
5.Anubha Kaushik , C.P. Kaushik, "Perspectives in Environmental Studies", New Age International Pvt. Ltd, New Delhi, (2004).
6.Frank R. Spellman, "Handbook of Environmental Engineering", CRC Press, (2015).

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Obtain knowledge about environment, ecosystems and biodiversity.
CO2	Take measures to control environmental pollution.
CO3	Gain knowledge about natural resources and energy sources.
CO4	Find and implement scientific, technological, economic and political solutions to environmental problems.
CO5	Understand the impact of environment on human population.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1	1	1	1	1	2	1	2	1	2	1	3	2	2	2
CO2	1	2	3	3	1	3	3	2	1	2	1	3	2	2	1
CO3	2	2	2	1	2	2	1	2	1	2	1	3	2	2	3
CO4	1	1	3	2	2	2	3	3	2	2	1	2	1	2	2
C05	2	2	3	2	1	2	2	1	2	1	2	3	3	3	1

GE1205	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
	(Common to BioTech, CHEMICAL, EEE, EIE)	3	0	0	3

Objectives

- The objective of this course is to introduce basic knowledge on Civil Engineering Materials, Surveying, Foundations, Civil Engineering Structures, IC Engine, Working Principle of Power Plant, Accessories Of Power Plant, Refrigeration And Air Conditioning System

UNIT – I	SCOPE OF CIVIL AND MECHANICAL ENGINEERING	6

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.

UNIT - II	SURVEYING AND CIVIL ENGINEERING MATERIALS	9

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	12

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

Civil Engineering Structures: Brick masonry – 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.

UNIT - IV	INTERNAL COMBUSTION ENGINES AND POWERPLANTS	12

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	6

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.

TOTAL : 45 PERIODS

TEXT BOOKS

1.Shanmugam G and Palanichamy MS, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., NewDelhi, 1996.

REFERENCE BOOKS

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.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To impart basic knowledge on Civil and Mechanical Engineering.
CO2	To familiarize the materials and measurements used in Civil Engineering.
CO3	To provide the exposure on the fundamental elements of civil engineering structures.
CO4	To enable the students to distinguish the components and working principle of power plant, IC engines
CO5	To provide the exposure on the fundamental elements of R & AC system.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	2	3	3	3	-	3	2	2	3	3	2	2
CO2	3	2	3	3	3	3	2	-	2	1	1	3	3	2	1
CO3	3	2	3	3	2	3	2	-	3	2	1	3	3	2	1
CO4	3	2	3	2	2	3	2	-	3	2	2	3	3	3	2
C05	3	2	3	2	2	3	2	-	2	2	1	3	2	3	2

EE1271	**PRINCIPLES OF ELECTRICAL, ELECTRONICS AND COMMUNICATION ENGINEERING**	**L**	**T**	**P**	**C**
	(Common to EEE & EIE)	3	0	0	3

Objectives

o understand the basic concepts of electric circuits and wiring practices.

o study about the three phase system and magnetic circuits

o understand the working principle of electronic devices.

o study the working of current controlled and voltage controlled devices.

o understand the basic concepts of communication systems.

UNIT I	**BASIC ELECTRIC CIRCUITS AND DOMESTIC WIRING**	**9**

Electrical circuit elements (R, L and C)-Dependent and independent sources - Ohm's Law, Kirchhoff's

laws - Single phase AC circuits: Phasor – RMS and Average values-sinusoidal steady state response of simple RLC circuits - Types of wiring- Domestic wiring - Electrical Safety - Protective devices and Earthing.		
UNIT II	**THREE PHASE CIRCUITS AND MAGNETIC CIRCUITS**	**9**
Evolution of Three phase circuits from single phase circuits – Star connection – Delta connection – Balanced and Unbalanced Loads- Power in three-phase circuits -Magnetic circuits- Definitions-MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Fringing, self and mutual inductances-simple problems.		
UNIT III	**BASICS OF ELECTRONICS**	**9**
P-N junction diode - VI Characteristics, static and dynamic resistance, Diffusion and drift current densities, transition & diffusion capacitance - Zener diode - VI Characteristics, Zener and avanlache Breakdown, Zener Voltage Regulator. Diode Rectifier & Filter circuits – LC Filters-PIN and Photo Diode, Photo Transistor.		
UNIT IV	**CURRENT CONTROLLED AND VOLTAGE CONTROLLED DEVICES**	**9**
Current controlled devices: Construction, operation and characteristics of BJT, UJT, and SCR. Voltage controlled devices: Construction, operation and characteristics of JFET and MOSFET.		
UNIT V	**FUNDAMENTAL OF COMMUNICATION ENGINEERING**	**9**
Introduction – Elements of communication systems – Modulation and Demodulation: principle pf amplitude and frequency modulation. Digital communication - Nyquist Sampling Theorem, Pulse Code Modulation, Delta Modulation, BPSK, QPSK(Qualitative Approach)- Communication systems: Radio Antenna, TV, satellite and optical fibre (Block diagram approach only).		
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, McGraw Hill Education, 2014.
2. Del Toro, “Electrical Engineering Fundamentals”, Second edition, Pearson Education, New Delhi, 2015.
3. John Bird, “Electrical Circuit theory and technology”, Routledge; 5th edition, 2013.

REFERENCE BOOKS

1.Thomas L. Floyd, ‘Electronic Devices’, 10th Edition, Pearson Education, 2018.

2.Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7thedition, 2017.

3.Kothari DP and I.J Nagrath, “Basic Electrical Engineering”, McGraw Hill, 2010.

4.Muhammad H.Rashid, “Spice for Circuits and electronics”, 4th edition. Cengage 2019.

5.V.K. Mehta and Rohit Mehta, 'Principles of Power System', S.Chand Publishers, Reprint Edition 2019.

6. Taub & Schiling "Principles of Communication Systems" Tata McGraw Hill 4th edition 2017

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	To be able to understand the concepts related with electrical circuits and wiring practices.
CO2	To be able to study the different three phase connections and the concepts of magnetic circuits.
CO3	To be able to understand the working principle of electronic devices such as diode and zener diode.
CO4	To be able to understand the characteristics and working of current controlled and voltage controlled devices.
CO5	To be able to understand the basic concepts of communication systems.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	2	3	3	2	1	3	2	2	3	3	2	2
CO2	3	3	3	2	2	1	3	1	1	2	2	2	3	2	2
CO3	3	3	3	2	2	1	2	1	1	1	2	3	3	2	2
CO4	3	3	3	2	1	2	2	1	1	1	1	2	3	2	2
C05	3	2	1	2	1	1	2	1	1	1	1	2	3	2	2

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GE 1207	**ENGINEERING PRACTICES LABORATORY**	**L**	**P**	**T**	**C**
	(Common for all branches of B.E. / B. Tech Programmes)	**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

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL)

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 equipment's – 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.

Soldering practice – Components Devices and Circuits – Using general purpose PCB. Measurement of ripple factor of HWR and FWR.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No.	Description of Equipment	Quantity required
	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.	**15 Sets.**
4.	Models of industrial trusses, door joints, furniture joints	**5 each**
5.	**Power Tools:** (a) Rotary Hammer (b) Demolition Hammer (c) Circular Saw (d) Planer (e) Hand Drilling Machine (f) Jigsaw	**2 Nos**
	MECHANICAL	
1.	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.	**1 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 (b) Digital Live-wire detector	**2 Nos**
	ELECTRONICS	
1.	Soldering guns 10 Nos.	**10 Nos.**
2.	Assorted electronic components for making circuits 50 Nos.	**50 Nos.**
3.	Small PCBs.	**10 Nos.**
4.	Multimeters	**10 Nos.**
5.	**Study purpose items:** Telephone, FM radio, low-voltage power supply	**1 each**

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Fabricate carpentry components and pipe connections including plumbing works. Use welding equipment's to join the structures.
CO2	Carry out the basic machining operations Make the models using sheet metal works
CO3	Carry out basic home electrical works and appliances.
CO4	Measure the electrical quantities
CO5	Elaborate on the components, gates, soldering practices

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	1	3	0	0	3	0	0	0	0	0	3	3	2	3
CO2	3	2	3	0	0	3	0	0	0	0	0	3	3	2	2

CO3	3	1	2	0	0	2	0	0	0	0	0	3	3	2	3
CO4	3	2	3	3	1	3	1	1	1	1	2	3	3	3	3
C05	3	2	3	3	1	2	1	1	1	1	2	3	3	3	3

EE1278	**PRINCIPLES OF ELECTRICAL AND ELECTRONIC DEVICES LABORATORY**	**L**	**T**	**P**	**C**
	(Common to EEE & EIE)	0	0	4	2

Objectives

- To provide practical knowledge of fundamental concepts of electrical and electronics engineering through relevant experiments.
- To impart hands on experience in measurement of electric and magnetic circuit parameters.
- To train the students in performing the verification of ohm's law and Kirchhoff's laws.
- To analyse various connections of balanced and unbalanced loads.
- To study the characteristics of electronic semiconductor devices.

LIST OF EXPERIMENTS

1. Measurement of equivalent Resistance in an electric circuit
2. Verification of ohm's law.
3. Verification of Kirchhoff's laws.
4. Measurement of magnetic flux in magnetic circuits.
5. Star and delta connections with balanced and unbalanced loads.
6. V-I characteristics of PN junction and Zener Diode.
7. V-I characteristics of SCR.
8. V-I characteristics of BJT (CE, CB, CC Configuration).
9. V-I characteristics of FET.
10. V-I characteristics of UJT and its application.

TOTAL : 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Dual,(0-30V) variability Power Supply- 10 Nos
2. CRO-10 Nos-30MHz
3. Function Generator – 10 Nos- 1 MHz
4. Digital Multimeter -10 Nos
5. Bread board – 10 Nos
6. Digital Trainer Kit
7. Watt meter-2Nos.
8. Ammeter (0-10A)-10 Nos
9. Voltmeter (0-300V)-10Nos
10. Fluxmeter-2 Nos

11.Load Resistor Box-1Nos.

Consumables Sufficient Quantity

1. Resistor
2. BJT
3. UJT
4. Diodes
5. Zener Diode.
6. FET

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Manipulate simple electric and magnetic circuits.
CO2	Become familiar with the basic ohm's and kirchhoff's law realization.
CO3	Design and Analyse the basic circuit components and connect them to make a real electrical circuit.
CO4	Ability to Design and construct basic load connections of electrical networks
CO5	To study and analyse the characteristics of various electronic semiconductor devices.

MAPPING OF COs WITH POs AND PSOs

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	3	1	1	1	2	1	2	2	3	2	2
CO2	3	3	3	3	3	2	1	1	2	1	1	3	3	2	2
CO3	3	3	3	3	3	1	2	1	2	1	2	2	3	2	2
CO4	3	3	3	3	3	1	1	1	2	1	2	2	3	2	2
C05	3	3	3	3	3	2	1	1	2	1	1	3	3	2	2

SEMESTER III

MA1301	TRANSFORM AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
(Common to Civil, EEE, EIE, Mech and Biotech)		4	0	0	4

Objectives

- To introduce the basic concepts of Partial differential equation and to find its solutions.
- To introduce Fourier series analysis which is vital to many applications in engineering apart from its use in solving boundary value problems?
- To acquaint the student with Fourier series techniques to solve heat and wave flow problems in engineering.
- To familiarize the student with Fourier transform techniques used in solving various practical engineering problems.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop 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 (except $f(x^m z^k p, y^n z^k q) = 0$) – 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 -Necessary and sufficient condition for existence of Fourier series – 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 Periods:	60

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.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.

Reference Books:

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. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

Course Outcomes (CO)

CO1	Understand how to solve the partial differential equations and apply these concepts in the field of engineering.
CO2	Learn Fourier series analysis which plays a vital role in the application of electrical engineering, vibration analysis, acoustics, optics, signal and image processing.
CO3	Appreciate the physical significance of Fourier series techniques in solving one and two Dimensional heat flow problems and one dimensional wave equations and this concept is applied in the fields like elasticity, heat transfer ,quantum mechanics and also extensively in physical phenomenon.
CO4	Understand the mathematical principles on transforms and gain the ability to formulate and solve some of the physical problems like designing electrical circuits, signal processing, signal analysis ,image processing etc.
CO5	Learn to use the effective mathematical tools like Z- transform for the solving difference equations in discrete time signals

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	2	2	1	1	2	0	2	1	2	0	3	1	1	1
CO2	3	3	2	2	1	2	1	0	1	0	2	0	3	2	1	2
CO3	3	3	2	2	0	1	0	0	1	0	2	0	3	1	1	1
CO4	3	2	1	2	1	0	1	1	0	0	3	0	2	2	2	2
CO5	3	3	2	2	1	0	1	0	2	1	2	0	3	1	2	2

EI1301	ELECTRICAL AND ELECTRONIC MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge in the specific area of electrical measuring instruments. Emphasis is laid on the meters used to measure current, voltage, power and energy.
- Elaborate discussion about potentiometer and to impart knowledge on various instrument transformers and to understand the calibration of various meters.
- Elaborate study about various resistance and impedance measurement techniques
- In-depth understanding and idea of analog and digital instruments
- Detailed study of display and recording devices

Unit-I **MEASUREMENT OF BASIC ELECTRICAL PARAMETERS** **9**

Galvanometers – D'Arsonval galvanometer – Theory, application –Principle, construction, operation of moving coil, moving iron meters, Electrodynamometer & induction type – Extension of range and calibration of voltmeter and ammeter – Errors and compensation Electrodynamometer type wattmeter – Theory & its errors – Methods of correction – LPF wattmeter– Induction type energy meter – Phantom loading

Unit-II **POTENTIOMETERS, INSTRUMENT TRANSFORMERS** **9**

DC potentiometer – Basic circuit, standardization – Laboratory type (Crompton's) – AC potentiometer – Drysdale (polar type) type – Gall-Tinsley (coordinate) type – Limitations & applications – Current Transformer and Potential Transformer construction, theory, operation, phasor diagram, characteristics, testing, error elimination – Applications.

Unit-III **RESISTANCE AND IMPEDANCE MEASUREMENT** **9**

Measurement of low, medium & high resistance – Ammeter, voltmeter method – Wheatstone bridge – Kelvin double bridge – Series and shunt type ohmmeter –High resistance measurement – Megger – Direct deflection methods – guard wire method – Loss of charge method – A.C bridges– Measurement of inductance, capacitance – Maxwell Bridge – Anderson bridge – Hay's bridge – Schering bridge – Wein's bridge – Campbell bridge to measure mutual inductance.

Unit-IV **ANALOG AND DIGITAL INSTRUMENTS** **9**

Digital voltmeter- various types, true RMS voltmeter and multi-meter – Microprocessor based DMM - Oscillators – Wien's bridge, RC phase shift, Hartley, Crystal oscillators – Signal and function generators – pulse and square wave generator – Applications –wave analyzer - Harmonic distortion analyzer – Spectrum analyzer – Applications

Unit-V **DISPLAY DEVICES, VIRTUAL INSTRUMENTATION AND TELEMETRY** **9**

Cathode ray oscilloscope: Classification, Sampling and storage scopes – LED, LCD displays – X-Y recorders – Magnetic tape recorders — Data Loggers – Introduction to Virtual Instrumentation – block diagram - Data acquisition – General Telemetry system – various types.

TOTAL :45 PERIODS

COURSE OUTCOMES

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

CO1	An ability to compare the working principles, merits, demerits and errors of different types of electrical instruments and can understand about different instruments that are used for measurement purpose.
CO2	Understanding of how different bridge networks are constructed and balanced for finding out

	values of resistance, capacitance and inductance
CO3	An ability to apply knowledge of electronic instrumentation for measurement of electrical quantities.
CO4	Able to understand the principle of various display devices, virtual instrumentation and telemetry.
CO5	Able to apply the principles and practices for instrument design and development to real world problems.

TEXT BOOKS	
1.	Kalsi, H.S., " Electronic Instrumentation", Tata McGraw-Hill, New Delhi, 2010
2.	Sawhney, A.K., "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co., New Delhi, 2010

REFERENCES	
1.	Northrop, R.B., "Introduction to Instrumentation and Measurements", Taylor & Francis, New Delhi, 2008.
2.	Carr, J.J., "Elements of Electronic Instrumentation and Measurement", Pearson Education India, New Delhi, 2011.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CO2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
CO3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CO4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
CO5	0	0	0	0		0	0	0	0	0	0	0	0	0	0

EI1302	**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 – Fibre 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), Introduction to Agricultural Sensors- Sensor Fusion		
		TOTAL: 45 PERIODS
COURSE OUTCOMES At the end of the course, the student should have the:		
CO1	To apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications	
CO2	To determine the static and dynamic characteristics of transducers using software packages and to analyze the problems related to sensors & transducers.	
CO3	To understand about the Principle and constructional details of variable resistance transducer	
CO4	To understand about the Principle and constructional details of variable capacitive and inductive transducers.	
CO5	To apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications	
TEXT BOOKS		
3.	Doebelin E.O. and Manik D.N., “Measurement Systems”, 6th Edition, McGraw-Hill Education Pvt. Ltd., 2011.	
4.	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.	Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', McGraw Hill, 2003.
5.	W.Bolton, Engineering Science, Elsevier Newnes, Fifth edition, 2006
6.	Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
7.	Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	2	1	1	-	-	-	-	-	-	2	3	2	2
CO2	3	3	2	2	2	-	-	-	-	-	-	2	3	2	2
CO3	3	3	2	1	1	-	-	-	-	-	-	2	3	2	2
CO4	3	3	2	1	1	-	-	-	-	-	-	2	3	2	2
CO5	2	2	2	1	1	-	-	-	-	-	-	2	3	2	2

EE1371	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
	Common to EEE and EIE	2	1	0	3

Objectives

- To determine the response of electric circuits using basic analysis methods.
- To impart knowledge on solving circuit equations using network theorems.
- To Analyse the transient behaviour of electric circuits with different types of source.
- To understand the concepts of resonance and coupled circuits.
- To Compute and analyse the two-port network and its parameters.

UNIT - I	ANALYSIS OF ELECTRIC CIRCUITS & NETWORK TOPOLOGY	9

Mesh Analysis - Analysis with independent and dependent voltage sources, Supermesh Analysis. Node Analysis - Analysis with independent and dependent current sources, Supernodal Analysis. Introduction to graph theory - Network terminology. Duality and dual networks.

UNIT - II	NETWORK THEOREMS FOR DC AND AC CIRCUITS	9

Network reduction: voltage and current division, source transformation, star delta conversion. Applications of: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem, Mill man's theorem.

UNIT - III	TRANSIENT RESPONSE ANALYSIS	9

Transient response: Natural response & Forced response of RL, RC and RLC circuits using Laplace transform for DC input and AC sinusoidal input.

UNIT - IV	RESONANCE AND COUPLED CIRCUITS	9

Series and parallel resonance: Variation of impedance with frequency - Variation in current through and voltage across L and C with frequency – Bandwidth - Q factor - Selectivity. Mutual coupled circuits: Self and mutual inductance – Coefficient of coupling – Dot Convention in coupled circuits. Ideal Transformer. Tuned circuits – single tuned circuits.

UNIT - V	**TWO PORT NETWORK AND NETWORK FUNCTIONS**	**9**

Two Port Networks, terminal pairs, relationship of two port variables, impedance(Z) parameters, admittance(Y) parameters, transmission parameters (ABCD) and hybrid parameters(H), interconnections of two port networks.

Total Periods:	**45**

Text Books:

1. M Nahvi I J A Edminster “Electric Circuits”; Schaum's outline series, Tata Mcgraw Hill companies, 4th Edition, 2019.
2. Charles K. Alexander, Mathew N.O. Sadiku, “Fundamentals of Electric Circuits”, Fifth Edition, McGraw Hill, 2020.
3. David A Bell,” Electric circuits “, Oxford University Press, 2019.

Reference Books:

1. K. V. V. Murthy and M. S. Kamath, “Basic Circuit Analysis”, Jaico Publishers, 2017.
2. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, “Engineering Circuits Analysis”,Tata McGraw Hill publishers, New Delhi, 2019.
3. Sudhakar. A, Shyammohan. S.P “Circuits and Networks-Analysis and Synthesis”. Tata McGraw Hill publishers, 2018.
4. M. E. Van Valkenburg, “Network Analysis”, Prentice Hall, 2020.
5. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 2018.

Course Outcomes (CO)

CO1	Able to Determine the response of Electric circuits using basic analysis methods and network topology
CO2	Able to Compute the response of electric circuits using network theorem in real time applications.
CO3	Able to Apply Laplace transform techniques for solving problems and discuss the complete response of circuits.
CO4	Able to Design and analyse resonance and coupled circuits.
CO5	Able to Evaluate and analyse two port networks and its parameters.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO2	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO3	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO4	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
C05	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2

EE1372	ANALOG ELECTRONICS	L	T	P	C
	(Common to EEE and EIE)	3	0	0	3

Objectives

- To be familiar with the biasing of BJT and its amplifier circuits
- To analyse the operation of feedback amplifiers and oscillators
- To study the characteristics of Op-Amp.
- To design and construct application circuits with Op-amp IC's
- To study the functional blocks and the applications of special ICs like 555, 565 and 566 and voltage regulator ICs

UNIT - I	BIASING METHODS AND AMPLIFIER CIRCUITS	9

PN diode : Intrinsic and Extrinsic semiconductors – Formation of PN junction – biasing- VI characteristics of diode -BJT -Need for biasing, DC Load Line and Bias Point, Various biasing methods of BJT, BJT small signal model, Analysis of CE amplifier, Gain and Frequency response, Differential Amplifier - Common mode and Differential mode analysis - Multi-stage amplifier.

UNIT - II	FEEDBACK AMPLIFIERS AND OSCILLATORS	9

Feedback Concepts, gain with feedback, effect of feedback on gain stability, distortion, bandwidth, input and output impedances. Topologies of feedback amplifiers - analysis of series-series, shunt-shunt, series-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation. Barkhausen criterion for oscillation, Types of oscillators –RC, LC and crystal oscillators.

UNIT - III	OP-AMP CHARACTERISTICS AND ITS BASIC APPLICATIONS	9

Basic introduction to IC fabrication. Op-Amp characteristics: DC characteristics, AC characteristics. Basic applications: Inverting, Non-inverting, Adder, Subtractor, Differential amplifier, Instrumentation amplifier, Differentiator, Integrator circuit and Comparators.

UNIT - IV	APPLICATIONS OF OP-AMP	9

V to I, I to V converter, Multi-vibrators, Triangular wave generators, Precision rectifier, Clippers and Clampers, Peak detector, Sample and hold Circuit. First-order and Second order active filters, A/D converters: Flash, Dual slope and Successive Approximation type. D/A converters: Weighted resistance type and R-2R ladder type.

UNIT - V	SPECIAL ICS	9

555-Timer circuit, Functional block diagram, characteristics & applications, Astable and Monostable multivibrator, 566-Voltage Controlled Oscillator circuit, 565-Phase Locked Loop and its applications, IC8038-Function generator, Linear Voltage regulators: Functional Block diagram : 78XX, 79XX, LM317, IC723 general purpose regulator - SMPS.

	Total Periods:	**45**

Text Books:

1. David A bell, "Electronic circuits", Oxford University Press, 2011.
2. D. Roy Choudhary, Sheil B. Jani, 'Linear Integrated Circuits', Fourth edition, New Age, 2012.

3. Ramakant A.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2015.

Reference Books:

1. Millman and Halkias, "Integrated Electronics", McGraw Hill Publications, 2008.
2. Muhammad H. Rashid, "Linear Integrated Circuits", Cengage Learning, 2014.
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. Fiore,"Opamps& Linear Integrated Circuits Concepts & applications", Cengage, 2010.
6. Floyd, Buchla,"Fundamentals of Analog Circuits, Pearson, 2013.

Course Outcomes (CO): At the end of the course students will have the,

CO1	Ability to understand the biasing concepts of BJT and its amplifier circuits.
CO2	Ability to design circuits employing amplifier and oscillator circuits.
CO3	Ability to analyse, comprehend and design of analog electronic circuits involving Op-Amp
CO4	Ability to analyse and design applications using IC741 operational amplifier.
CO5	Ability to design analog integrated circuits using 555 timer, PLL, VCO, voltage regulator and other special ICs.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	3	3	3	1	1	1	3	2	2	3	3
CO2	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3
CO3	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3
CO4	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3
CO5	3	3	3	3	3	1	2	1	3	1	3	2	2	3	3

EE1373	DIGITAL LOGIC CIRCUITS	L	T	P	C
	(Common to EEE, EIE)	2	1	0	3

Objectives

•To study number systems and the performance characteristics of digital logic families like DTL, TTL, ECL and CMOS.
•To study combinational circuits and implement it.
•To design synchronous sequential circuits.
•To introduce asynchronous sequential circuits and PLDs
•To gain knowledge on VHDL coding style.

UNIT - I	NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES	9

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	9

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	9

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 PROGRAMMABLE LOGIC DEVICES	9

Asynchronous sequential logic circuits-Transition stability, flow stability-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	9

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

Total Periods:	**45**

Text Books:

1. James W. Bignel, 'Digital Electronics', Cengage learning, 5thEdition, 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.

Reference Books:

1. Mandal 'Digital Electronics Principles and 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.

Course Outcomes (CO) : At the end of the course students will have the,

CO1	Ability to compare the performance characteristics of various digital logic families like DTL, TTL, ECL, CMOS.
CO2	Ability to design and implement digital circuits using combinational circuits.
CO3	Ability to design sequential circuits
CO4	Ability to design asynchronous sequential circuits and PLDs
CO5	Ability to simulate using software package for development of real time logic circuits.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	3	2	-	-	-	-	-	-	-	-	1	3	-	-
CO2	1	3	2	-	-	-	1	-	-	-	-	1	3	-	-
CO3	3	2	1	-	-	-	1	-	-	-	-	1	3	-	-
CO4	3	2	1	-	-	-	1	-	-	-	-	1	3	-	-
CO5	1	3	2	-	1	-	1	-	-	-	-	1	2	1	-

EE1391	ANALOG AND DIGITAL ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

Objectives

- To be exposed to the operation and application of electronic devices and their circuits
- To analyze operation using Op-amp IC's.
- To design and construct application circuits with ICs as Op-amp, 555, etc.
- To learn design, testing and characterizing of circuit behaviour with digital ICs
- To impart the analysis of sequential and combinational circuit.

LIST OF EXPERIMENTS

1. Frequency response of CE Amplifier.
2. Design of an Oscillator- RC and LC oscillator using BJT.
3. Applications of Op-Amp: inverting, non-inverting amplifier, Adder, Comparator and differential amplifier
4. Design of Integrator, Differentiator, Clipper and Clamper
5. IC 555 Timer applications – Astable and Monostable operation
6. Design of Linear Voltage regulator
7. Implementation of Boolean Functions, Adder/ Subtractor circuits.
8. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
9. Encoders and Decoders
10. Counters: Design and implementation of 4-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
11. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.
12. Implementation of multiplexer and demultiplexer.

Total Periods: 60

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Dual (0-30V) variability Power Supply- 10 Nos
2. CRO-10 Nos-30MHz
3. Function Generator – 10 Nos.- 1 MHz
4. Digital Multimeter -10 Nos
5. IC Tester (Analog)- 2 Nos
6. Bread board – 10 Nos
7. Digital Trainer Kit

Consumables Sufficient Quantity

1. IC 741/ IC NE555

2. Digital IC types
3. LM317
4. Transistor – 2N3391, BC107, BC147
5. Diodes - IN4001, BY126
6. DIB, DCB
7. Capacitor
8. Resistors 1/4 Watt Assorted
9. Single Strand Wire
10.Potentiometer 10K
11.Step Down Transformer -230V to 12 V
12.Rectifier IC W10

Course Outcomes (CO)

CO1	Ability to understand the operation and application of electronic devices and their circuits.
CO2	Ability to analyse, comprehend and design of analog electronic circuits involving OP-AMP
CO3	Ability to analyse, comprehend and design of analog electronic circuits involving timer 555
CO4	Ability to learn, design, test and analyse digital ICs
CO5	Ability to analyse the sequential and combinational circuit

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	3	3	3	1	3	1	3	1	2	3	3
CO2	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3
CO3	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3
CO4	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3
CO5	3	3	3	3	3	2	2	1	3	1	3	1	2	3	3

EI1308	ELECTRICAL AND ELECTRONICS MEASUREMENT LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

•	Simulate, understand and experimentally verify the electric circuit laws
•	Simulate, identify network theorems and their application to network reduction techniques
•	To be familiar with the structure of basic electronic devices
•	To be exposed to the operation and application of electronic devices and their circuits
•	To analyze circuit characteristics with signal analysis using Op-amp Ics.

S. NO	LIST OF EXPERIMENTS
1.	Simulation and experimental verification of electrical circuit problems using Thevenin's and Norton's theorem.
2.	Simulation and experimental verification of electrical circuit problems using Superposition theorem.
3.	Simulation and experimental verification of Maximum Power transfer Theorem.
4.	Study of CRO and measurement of sinusoidal voltage, frequency and power factor

5.	Simulation and Experimental validation of RC and RLC electric circuit transients.
6.	Design and Simulation of series and parallel resonance circuit.
7.	Displacement versus output voltage characteristics of a potentiometric transducer.
8.	Wheatstone and Kelvin's bridge for measurement of resistance.
9.	Schering Bridge for capacitance measurement and Anderson Bridge for inductance measurement.
10.	Calibration of Ammeter and Voltmeter using Shunt type potentiometer.
11.	Calibration of Single-phase wattmeter.
12.	Calibration of Single-phase Energy meter
	TOTAL :60 PERIODS
	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 - 6 Nos each. Circuit Connection Boards - 10 Nos. Necessary Quantities of Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)

COURSE OUTCOMES

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

CO1	Ability to understand and simulate the electric circuit laws
CO2	Ability to understand and simulate the network theorems and their application to network reduction techniques
CO3	Ability to understand the structure and underlying semiconductor physics concepts.
CO4	Ability to design circuits employing electronic devices.
CO5	Analyze, comprehend and design of analog electronic circuits involving OP-AMP

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	-	1	1	2	-	-	-	-	-	-	-	2	1	-
CO2	2	-	1	1	2	-	-	-	-	-	-	-	2	1	-
CO3	2	-	1	1	2	-	-	-	-	-	-	-	2	1	-
CO4	2	-	1	1	2	-	-	-	-	-	-	-	2	1	-
CO5	2	-	1	1	2	-	-	-	-	-	-	-	2	1	-

SEMESTER IV

MA1401	STATISTICS AND NUMERICAL METHODS	L	T	P	C
	(Common to MECH, EEE & EIE)	4	0	0	4

Objectives

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the Interpolation operators and numerical techniques of interpolation in various intervals, 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.

UNIT – I	TESTING OF HYPOTHESIS	12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) -Goodness of fit

UNIT – II	DESIGN OF EXPERIMENTS	12

One way and two-way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT – III	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 – Eigen values of a matrix by Power method.

UNIT – IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	12

Interpolation operators (Forward, Backward, shifting operators and its Properties) –– Newton's forward and backward difference interpolation for equal intervals – Lagrange's and Newton's divided difference interpolations for unequal intervals - Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT – V	NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	12

Finite difference methods for solving second order two - point linear boundary value problems 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.

Total Periods:	**60**

Text Books:

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition,

Khanna Publishers, New Delhi, 2015.

2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

Reference Books:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.
4. Sankara Rao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and scientists" 8th edition, Pearson Education, Asia, 2007.

Course Outcomes (CO)

CO1	Students will gain knowledge on Large Samples and Small Samples. These concepts are very useful in Biological, Electric power management, Social experiments and also in all kinds of generalizations based on information about a smaller sample and larger samples. Apply the appropriate test in the problems related with sampling.
CO2	ANOVA's statistical significance result is independent of constant bias and scaling of errors. It is used in testing the difference between several treatments in the Design of experiments. It checks the impact of one or more factors in any experiment in Engineering.
CO3	Students will learn on nonlinear (algebraic or transcendental) equations and linear equations. Students learn to solve the Eigen value problem of a matrix numerically when analytical methods tend to fail to give solution and apply all these in the fields like Vibrating systems, fluid dynamics.
CO4	Students will learn to construct approximate polynomials that can be used in data representation using interpolation techniques to find the intermediate values. In particular, interpolation methods are extensively applied in the models of the different phenomena where experimental data must be used in computer studies where expressions of those data are required. The learners are introduced to numerical differentiation and integration techniques. The techniques are useful when the function in the analytical form is complicated**.**
CO5	Students get an insight on ordinary differential equations which will be useful in solving engineering problems. Students learn about the different methods for solving first order and second order differential equations. It will be useful in attempting any engineering problems. ODE is applied in specific mathematical fields like Electrical, Geometry, Analytical mechanics, Celestial mechanics and Weather modelling.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**	**4**
CO1	2	3	3	3	2	3	2	-	2	-	2	2	2	2	1	2
CO2	2	3	3	3	3	2	2	-	2	-	2	2	2	1	1	2
CO3	2	3	2	2	1	-	-	-	-	-	-	2	2	2	2	1
CO4	3	3	3	2	2	1	-	-	-	-	-	2	2	1	2	1
CO5	3	3	2	1	2	1	-	-	-	-	-	2	2	2	2	1

EI1401	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 colour radiation pyrometers – Fiber optic sensor for temperature measurement – Thermograph, Temperature switches and thermostats – Temperature sensor selection, Installation and Calibration- Smart Temperature transmitter.

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-Smart Pressure transmitter.

TOTAL : 45 PERIODS

COURSE OUTCOMES	
At the end of the course, the student will have the:	
CO1	Understand the construction and working principle of various types of transducers/sensor to measure physical quantities such as force, torque and speed.
CO2	Understand the construction and working principle of various types of transducers/sensor to measure physical quantities such as acceleration, vibration and density.
CO3	Understand the construction and working principle of measuring Viscosity, Humidity and moisture
CO4	Understand working of different types of temperature measuring instruments like RTD, Thermistor.
C05	Understand working of additional types of temperature measuring instruments like thermocouple and radiation pyrometer.

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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	-	-	2	2	2	2	1	-	-	-	-	-	-	2	-
CO2	-	-	2	2	2	2	1	-	-	-	-	-	-	2	-
CO3	-	-	2	2	2	2	1	-	-	-	-	-	-	2	-
CO4	-	-	2	2	2	2	1	-	-	-	-	-	-	2	-
CO5	-	-	2	2	2	2	1	-	-	-	-	-	-	2	-

EI1451	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To introduce about D.C Machines
•	To introduce about Transformers
•	To introduce and educate about Synchronous Machines
•	To introduce and Educate about Three Phase Induction Motors
•	To introduce and educate about Single Phase Induction Motors
•	To introduce and educate about special electrical machines

UNIT I	D.C.MACHINES	9
D.C. Machines: – Principle of operation and construction of motor and generator – torque equation – Armature Reaction-Various excitation schemes – Characteristics of Motor and Generator – Starting, Speed control of D.C. Motor. Applications of DC Motor and Generator		
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 (L:45):45 PERIODS		

COURSE OUTCOMES

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

CO1	Ability to understand about D.C Machines
CO2	Ability to understand about Transformers
CO3	Ability to understand about Synchronous Machines
CO4	Ability to understand about Single Phase Induction Motors
CO5	Ability to understand about special electrical machines

TEXT BOOKS

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

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.	NPTEL Video Lecture series on "Electrical Machines I" and "Electrical Machines II" by Dr. Krishna Vasudevan, IIT Madras.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	2	-	1	-	-	-	-	1	2	2	-
CO2	3	3	3	3	3	-	1	-	-	-	-	1	2	2	-
CO3	3	3	3	3	2	-	1	-	-	-	-	1	2	2	-
CO4	3	3	3	3	3	-	1	-	-	-	-	1	2	2	-
CO5	3	3	3	3	3	-	1	-	-	-	-	1	2	2	-

EI1402	COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE 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 COMMUNICATION	9
Amplitude Modulation - Generation & Detection methods of AM, DSBSC - Generation & Detection methods of SSBSC, VSB - PSD, modulators and demodulators - Angle modulation - FM modulators and demodulators - PM modulators and demodulators , FM and PM – frequency spectrum - power relations : NBFM & WBFM - Nonlinear Effects in FM Systems - Armstrong method & Reactance modulation.		
UNIT II	**PULSE MODULATION**	**9**
Low pass sampling theorem – Quantization – PAM - Line coding - PCM, DPCM,DM, 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 signalling M-ary PSK -QAM		

Comparison, ISI - Pulse shaping - Duo binary encoding - Cosine filters - Eye pattern -Equalizers.		
UNIT IV	**INFORMATION THEORY & 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 - Convolutional Coding - Sequential decoding - Viterbi decoding .		
UNIT V	**SPREAD SPECTRUM & MULTIPLE ACCESS**	**9**
PN sequences - properties - m-sequence - DSSS - Processing gain, Jamming - Frequency domain representation of Noise - Mathematical Representation of Noise.- FHSS - Synchronisation and tracking Multiple Access - FDMA, TDMA, CDMA.		
TOTAL (L: 45+T: 0): 45 PERIODS		

COURSE OUTCOMES

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

CO1	Ability to comprehend and appreciate the significance and role of this course in the present contemporary world
CO2	To use data and pulse communication techniques
CO3	Apply digital communication techniques
CO4	Analyze Source and Error control coding
CO5	An in- depth knowledge of Spread Spectrum and Multiple Access Techniques

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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	0	2	0	0	0	1	0	0	0	0	1	2	1	0
CO2	3	0	2	0	0	0	1	0	0	0	0	1	2	1	0
CO3	3	0	2	0	0	0	1	0	0	0	0	1	2	1	0
CO4	3	0	2	0	0	0	1	0	0	0	0	1	2	1	0
CO5	3	0	2	0	0	0	1	0	0	0	0	1	2	1	0

EE1471	CONTROL SYSTEMS	L	T	P	C
	(Common to EEE and EIE)	2	1	0	3

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 -Feed forward and Feedback control theory – 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 -Control Design Using State feedback.

Total Periods: 45

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.

Reference Books:

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", PearsonEducation, 2009.
3. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint2009.
4. RamesC.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.

Course Outcomes (CO)	
CO1	Ability to develop various representations of system and to reduce the complex systems into simpler system in transfer function.
CO2	Ability to do time domain analysis of various models of linear system and understand the use of controllers in closed loop system
CO3	Ability to do frequency domain analysis of various models of linear system
CO4	Infer the stability of systems and ability to design appropriate compensator for the given specifications
CO5	Ability to represent the system in state variable forms

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO2	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO3	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO4	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2
CO5	3	3	3	3	3	2	2	1	2	2	3	2	3	3	3	2

CS1406	FUNDAMENTALS OF DATA STRUCTURES IN C (INTEGRATED LAB)	L	T	P	C
	(Common to EEE & EIE)	3	0	2	4

OBJECTIVES

- To learn the features of C
- To learn the linear and non-linear data structures
- To explore the applications of linear and non-linear data structures
- To learn to represent data using Trees and graph data structure
- To learn the basic sorting, searching, and Hashing Algorithm

UNIT I	C PROGRAMMING BASICS	9 +6

Structure of a C program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in C – Managing Input and Output operations – Decision Making and Branching – Looping statements. Arrays – Initialization – Declaration – One dimensional and Two-dimensional arrays. Strings- String operations – String Arrays. Simple programs – matrix operations.

Lab Component

- **IMPLEMENTATION OF BASIC C PROGRAMS**
  Basic C Programs – looping, data manipulations and arrays.
- **IMPLEMENTATION OF STRING HANDLING FUNCTIONS**
  Programs using strings – string function implementation.

UNIT II	FUNCTIONS, POINTERS, STRUCTURES AND UNIONS	9 + 6

Functions – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization –

Pointers arithmetic. Structures and unions - definition – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

Lab Component

- **IMPLEMENTATION OF USER DEFINED DATA TYPES**
  a. Programs using structures and pointers.
  b. Programs involving dynamic memory allocations.

UNIT III	LINEAR DATA STRUCTURES	9 + 6

Arrays and its representations – Linked lists – Linked list-based implementation of Stacks and Queues – Evaluation of Expressions – Linked list based polynomial addition.

Lab Component

- **IMPLIMENTATION OF LINKED LIST**
  Write a C program to Design and implement Singly Linked List.
- **IMPLEMENTATION OF STACK AND QUEUE**
  Write a C program to implement the following
  a. Stack and its operations using Array and List
  b. Queue and its operations using Array and List.
- **APPLICATIONS OF LINEAR DATA STRUCTURES**
  a. Write a C program to design and implement polynomial addition using list.
  b. Write a C program to evaluate arithmetic expression.

UNIT IV	NON-LINEAR DATA STRUCTURES	9 + 6

Trees – Binary Trees – Binary tree representation and traversals –Binary Search Trees – Applications of trees. Graph and its representations – Graph Traversals – Topological Sort –Applications of graphs.

Lab Component

- **IMPLEMENTATION OF TREE**
  Write a C program to implement the following
  a. Construct binary search tree.
  b. Traverse the binary search tree recursively in pre-order, post-order and in-order.
  c. Count the number of nodes in the binary search tree
- **GRAPH TRAVERSAL**
  Write a C program to implement the following algorithms
  a. Depth first search.
  b. Breadth first search.

UNIT V	SEARCHING, SORTING AND HASHING TECHNIQUES	9 + 6

Linear Search – Binary Search. Bubble Sort – Insertion sort – Merge sort – Quick sort - Hash tables – Overflow handling.

Lab Component

- **SORTING &SEARCHING**
  Write a C program to implement the following sorting techniques to arrange a list of integers in ascending order.
  a. Quick sort
  b. Merge sort

c. Linear Search
d. Binary Search

- **IMPLEMENTATION OF HASHING TECHNIQUES**
  Write a C program to Implement the following techniques
  a. Linear Probing
  b. Quadratic Probing
  c. Double Hashing

PRACTICALS: 30 PERIODS THEORY: 45 PERIODS TOTAL : 75 PERIODS

TEXT BOOKS

1. Reema Thareja, ―Data Structures Using C, Second Edition, Oxford University Press, 2014.

REFERENCE BOOKS

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Fourth Edition, Pearson Education, 2013.
2. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, ―Fundamentals of Data Structures in C, Second Edition, University Press, 2008.

COURSE OUTCOMES

CO1	To know the basic concepts of C
CO2	Suggest appropriate linear data structure for any given data set.
CO3	To learn the concepts of non-linear data Structures
CO4	Modify or suggest new data structure for an application
CO5	Appropriately choose the sorting, Searching, Hashing algorithm for an application.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2	3
CO2	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2	3
CO3	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2	3
CO4	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2	3
CO5	3	3	3	2	2	2	-	-	-	2	2	2	3	3	2	3

EI1408	MACHINES AND CONTROL LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

•	To obtain the no load and load characteristics of D.C machines.
•	To obtain the speed characteristics of D.C motor.
•	To find out regulation characteristics of Transformer.
•	To calculate the steady state error of a system for standard input signals.
•	To analyse the stability of the system using time and frequency domain.

S.NO	LIST OF EXPERIMENTS
1.	Open circuit characteristics of D.C. shunt generator.
2.	Load characteristics of D.C. shunt generator.
3.	Break 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.
7.	Simulation and experimental verification of First order system
8.	Simulation of Second order system
9.	Compute the impulse, step, ramp and parabolic responses of the given system and calculate the steady state error.
10.	Determine the stability of the unity feedback system for the given open loop transfer function using bode, Nyquist and root locus.
11.	Determine the system controllability and observability and comment

Course Outcome:

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

CO1	Ability to make use of basic concepts to obtain the no load and load characteristics of D.C machines.
CO2	Analyze and draw conclusion from the characteristics obtained by conducting experiments on machines.
CO3	Ability to interpret characteristics of the system to develop mathematical model.
CO4	Ability to do time domain and frequency domain analysis of various models of linearsystem.
CO5	Ability to come out with solution for complex control problem.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	-	2	1	-	-	-	-	1	-	1	1	2	2	-
CO2	2	-	2	1	-	-	-	-	1	-	1	1	2	2	-
CO3	2	-	2	1	-	-	-	-	1	-	1	1	2	2	-
CO4	2	-	2	1	-	-	-	-	1	-	1	1	2	2	-
CO5	2	-	2	1	-	-	-	-	1	-	1	1	2	2	-

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1.	DC Shunt Motor with Loading Arrangement
2.	Single Phase Transformer
3.	Single Phase Induction Motor with Loading Arrangement

4.	Single Phase Auto Transformer
5.	Single Phase Resistive Loading Bank setup
6.	Sufficient number of Ammeters, Voltmeters, (or Multimeters), Switches, tachometers, Wattmeter.
7.	Simulation Software (5 Users) (Pspice / Matlab /other Equivalent software Package) with PC.

EI1409	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 make the student to study the Synchros and Proximity sensor
•	To make the students to study the digital transducer

S.NO	LIST OF EXPERIMENTS
1.	Displacement versus output voltage characteristics of a potentiometric transducer.
2.	Characteristics of Strain gauge and Load cell transducer.
3.	Characteristics of LVDT, Hall Effect transducer and Photoelectric tachometer.
4.	Characteristics of LDR, thermistor transducer.
5.	Step response characteristic of RTD and thermocouple transducers.
6.	Temperature measurements using RTD with three and four leads.
7.	Measurement of Angular displacement using resistive and Capacitive transducer.
8.	Characteristics of Synchros and Proximity sensor
9.	Level measurement using Ultrasonic transducer.
10.	Measurement of temperature using IR thermometer and IC sensor
11.	Study of Digital transducer
12.	Study of Smart transducers
	TOTAL: 60 PERIODS

COURSE OUTCOMES (COs)

S.NO	LIST OF EXPERIMENTS
CO1	Understand the concepts of measurement, error and uncertainty.
CO2	Understand the static and dynamic characteristics of measuring instruments.
CO3	Gain knowledge about the principle of operation and characteristics of different types of resistance, capacitance and inductance transducers.
CO4	Acquire knowledge of analyzing different stages of signal conditioning units.
CO5	. Acquire knowledge of advancement of digital transducers

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Strain gauge and Load cell trainer -1
2.	LVDT trainer -1
3.	Hall Effect transducer trainer -1

4.	Photoelectric tachometer tachometer -1
5.	LDR Trainer -1
6.	Thermistor, Thermocouple J and K type -1
7.	RTD 3 wire and 4 wire -1
8.	Synchros and Proximity sensor trainer -1
9.	Ultrasonic transducer setup -1
10.	Sufficient number of power supply, Galvanometer, Bread board, Multimeter, resistors, Decade Capacitance box, Decade resistance box, Decade Inductance box, CRO.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	2	2	1	-	1	-	-	1	-	-	1	2	2	1
CO2	2	2	2	1	-	1	-	-	1	-	-	1	2	2	1
CO3	2	2	2	1	-	2	-	-	1	-	-	1	2	2	1
CO4	2	2	2	1	-	1	-	-	1	-	-	1	2	2	1
CO5	2	2	2	1	-	1	-	-	1	-	-	1	2	2	1

HS1310	**PROFESSIONAL SKILLS LAB**	**L**	**P**	**T**	**C**
	(Common to CSE, EEE, CHEM, EIE,CIVIL, AI & DS)	0	0	2	1

OBJECTIVES

- 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.

LIST OF EXPERIMENTS

UNIT I **6**

Introduction to Soft Skills- Hard skills & soft skills - employability and career Skills—Grooming as a professional with values—Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language- General awareness of Current Affairs.

UNIT II **6**

Self-Introduction-organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation practice—– Making a Power Point Presentation -- Structure and format; Covering elements of an effective presentation; Body language dynamics. Making an Oral Presentation–Planning and preparing a model presentation; Organizing the presentation to suit the audience and context; Connecting with the audience during presentation; Projecting a positive image while speaking; Emphasis on effective body language

UNIT III **6**

Introduction to Group Discussion— Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies- Structure and dynamics of a GD; Techniques of effective participation in group discussion; Preparing for group discussion;

Accepting others' views / ideas; Arguing against others' views or ideas, etc.	
UNIT IV	**6**
Basics of public speaking; Preparing for a speech; Features of a good speech; Speaking with a microphone. (Famous speeches may be played as model speeches for learning the art of public speaking). Interview etiquette – dress code – body language – attending job interviews– telephone/skype interview -one to one interview &panel interview –Job Interviews: purpose and process; How to prepare for an interview; Language and style to be used in an interview; Types of interview questions and how to answer them.	
UNIT V	**6**
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	
LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS	
One Server	
30 Desktop Computers	
One Hand Mike	
One LCD Projector	

REFERENCE BOOKS

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

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Make effective presentations
CO2	Participate confidently in Group Discussions
CO3	Attend job interviews and be successful in them.
CO4	Develop adequate Soft Skills required for the workplace
CO5	Develop their speaking skills to enable them speak fluently in real contexts

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	0	2	0	2	1	0	0	0	2	3	0	0	2	2	0
CO2	0	2	0	2	0	0	0	0	2	3	0	0	2	0	0
CO3	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0
CO4	0	0	0	0	0	0	0	0	2	2	0	2	0	0	0
CO5	0	2	1	1	2	0	2	0	2	3	0	2	2	2	0

SEMESTER V

EE1571	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

Objectives

- To impart knowledge on different types of power semiconductor devices and their switching characteristics.
- To understand the operation, characteristics and performance parameters of uncontrolled and controlled rectifiers.
- To learn the Operation, switching techniques and basics topologies of DC-DC switching regulators.
- To Compute and analyse the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
- To understand the operation of AC to AC converter.

UNIT - I	POWER SEMI-CONDUCTOR DEVICES	9

Study of switching devices - SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT. Static characteristics: SCR, MOSFET and IGBT. Triggering and commutation circuit for SCR. Introduction to Driver and snubber circuits.

UNIT - II	UNCONTROLLED AND PHASE-CONTROLLED CONVERTERS	9

Uncontrolled converters- half bridge and full bridge converters. Controlled converters: 2-pulse, 3-pulse and 6-pulse converters – performance parameters. Effect of source inductance. Firing Schemes for converter. Dual converters. Applications-light dimmer, Excitation system.

UNIT - III	DC TO DC CONVERTERS	9

Step-down and step-up chopper: control strategy. Introduction to types of choppers: A, B, C, D and E - Switched mode regulators- Buck, Boost, Buck- Boost regulator. Introduction to Resonant Converters. Applications-Battery operated vehicles and Solar PV systems.

UNIT - IV	INVERTERS	9

Single phase and three phase voltage source inverters (both120^0 mode and 180^0 mode): Voltage& harmonic control- PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM. Introduction to space vector modulation. Current source inverter - Applications-Induction heating, UPS.

UNIT - V	AC TO AC CONVERTERS	9

Single phase and Three phase AC voltage controllers: Control strategy- Power Factor Control – Multistage sequence control. -Single phase and three phase cyclo - converters. Introduction to Matrix converters. Applications –welding.

Total Periods:	45

Text Books:

1. M.H. Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, third Edition, New Delhi, 2019.
2. P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2019.
3. Ashfaq Ahmed 'Power Electronics for Technology', Pearson Education, Indian reprint, 2018.

Reference Books:

1. Joseph Vithayathil,' Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint, 2019.
2. Philip T. Krein, "Elements of Power Electronics" Oxford University Press, 2019 Edition.
3. L. Umanand, "Power Electronics Essentials and Applications", Wiley, 2020.

4. Ned Mohan Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters,
5. S.Rama Reddy, 'Fundamentals of Power Electronics', Narosa Publications, 2018.
6. M.D. Singh and K.B. Khanchandani, "Power Electronics," Mc Graw Hill India, 2017.
7. JP Agarwal," Power Electronic Systems: Theory and Design" Pearson Education, 2019.

Course Outcomes (CO)

CO1	Ability to understand the operation of semiconductor devices and its dynamic characteristics.
CO2	Ability to analyse and choose the Uncontrolled and controlled converters for real time applications.
CO3	Ability to analyse the operation of DC- DC converter and its applications.
CO4	Able to Understand various PWM techniques and apply voltage control and harmonic elimination methods to inverter circuits.
CO5	Able to Understand the operation of AC voltage controllers and its applications.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO2	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO3	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO4	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2
CO5	3	3	3	3	3	1	1	1	1	1	1	1	3	3	2

EE1572	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
	(Common to EEE and EIE)	**3**	**0**	**0**	**3**

Objectives

- To study the architecture, pin diagram, memory organisation and interrupts of 8085 microprocessor and 8051 microcontroller.
- To study the addressing modes & instruction sets of 8085 and 8051.
- To develop skills in simple programming writing using assembly languages.
- To introduce commonly used peripherals/ interfacing ICs.
- To study and understand typical applications using 8085 and 8051.

UNIT – I	8085 PROCESSOR	9
Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Interrupts.		CO1

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 table - Subroutine instructions – stack, Timing diagram of instructions.		CO2

UNIT – III	PERIPHERAL INTERFACING	9
Study on need, architecture, configuration and interfacing, with ICs: 8251, 8253/8254, 8255, 8259, 8279, A/D and D/A converters & its Interfacing with 8085.		CO3

UNIT - IV	8051 MICRO CONTROLLER	9
Hardware Architecture, Pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timers-serial communication; Interrupts, Instruction sets- Data Transfer, Manipulation, Control Algorithms & I/O instructions; Addressing modes; Timing Diagram; Comparison to Programming concepts with 8085.		CO4

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.		CO5
	Total Periods:	45

Text Books:

1. R.S. Gaonkar, 'Microprocessor Architecture Programming and Application' with 8085, Wiley Eastern Ltd., New Delhi, 2013.
2. Sunil Mathur &Jeebananda Panda, "Microprocessor and Microcontrollers", PHI Learning Pvt. Ltd, 2016.
3. Muhammad Ali Mazidi& Janice GilliMazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 6th Indian reprint, 2013.

Reference Books:

1. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2nd edition, 2013.
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.

Course Outcomes (CO)

CO1	Ability to explain the architecture, memory organisation and interrupt structures of 8085 Microprocessor.
CO2	Ability to acquire knowledge in Addressing modes, instruction sets, timing diagram and to write the assembly language program of 8085 Microprocessor.
CO3	Ability to understand the importance of Interfacing with microprocessors and microcontrollers.
CO4	Ability to explain the architecture of Microcontroller, addressing modes & instruction sets of 8051.
CO5	Ability to develop the Microprocessor and Microcontroller based applications.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3	4
CO1	3	2	2	1	1	1	1	2	1	1	1	1	3	2	2	1
CO2	3	3	2	1	3	3	1	2	1	1	3	1	3	3	2	1
CO3	3	2	2	1	1	1	1	2	1	1	1	1	3	3	2	1
CO4	3	2	2	1	1	2	1	2	1	1	1	1	3	3	2	1
C05	3	3	3	3	3	3	1	2	1	1	3	1	3	2	2	1

EI1501	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE 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 oximeter - 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

Radiographic 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

CO1	Ability to understand the philosophy of the heart, lung, blood circulation and respiration system.
CO2	Ability to provide latest ideas on devices of non-electrical devices.
CO3	Ability to gain knowledge on various sensing and measurement devices of electrical origin.
CO4	Ability to bring out the important and modern methods of imaging techniques and their analysis.
CO5	Ability to explain the medical assistance/techniques, robotic and therapeutic equipment.

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.

MAPPING BETWEEN CO, PO AND PSO WITH CORRELATION LEVEL 1/2/3

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	-	-	2	2	2	1	-	-	-	-	-	1	2	2	-
CO2	-	-	2	2	2	1	-	-	-	-	-	1	2	2	-
CO3	-	-	2	2	2	1	-	-	-	-	-	1	2	2	-
CO4	-	-	2	2	2	1	-	-	-	-	-	1	2	2	-
CO5	-	-	2	2	2	1	-	-	-	-	-	1	2	2	-

EI1502	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) – Head type flowmeter – Principle, Construction and operations of Orifice plate and its different types, Venturi tube – Flow nozzle – Dall tube – Pitot tube: **:** combined pitot tube, averaging pitot tube, Cd variation – pressure tappings – Installation and applications of head flow meters

Unit-II	QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS	9

Positive displacement flow meters**:** Principle, Construction and operation of 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 meters:– Angular momentum – Thermal, Coriolis type mass flow meters – Calibration of flow meters: Dry and wet type, 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**:** Sight glass , 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 (L: 45+T: 30):75 PERIODS

COURSE OUTCOMES

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

CO1	Ability to understand the construction, installation and working of different variable head type flow meters.
CO2	To educate variable area flow meters, mass flow meters, electrical type, open channel and solid flow meters.
CO3	Able to understand the construction, working and calibration of different quantity flow meters,
CO4	Ability to gain knowledge about the construction, working and calibration of different type of transmitters.
CO5	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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	0	0	3	2	2	0	1	0	0	0	0	0	2	1	0
CO2	0	0	0	3	2	2	1	0	0	0	0	0	2	1	0
CO3	0	0	1	3	2	1	1	0	0	0	0	0	2	1	0
CO4	0	0	1	2	3	1	1	0	0	0	0	0	2	1	0
CO5	0	0	0	2	1	3	2	0	0	0	0	0	1	2	0

EE1591	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	L	T	P	C
		0	0	4	2

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. Read a key, interface display
7. Interface 8253 timer and perform mode-2 and mode-3 operation.
8. Demonstration of basic instructions with 8051 Micro controller
   - (i) Conditional jumps & looping
   - (ii) Calling subroutines.
9. Programming timer of 8051
10. Programming I/O Port of 8051 for
    - (i) Interfacing of A/D & D/A
    - (ii) Interfacing of DC & AC motors
11. Programming Practices with Simulators/Emulators/open source
12. Application hardware development using embedded processors.

Total Periods: 60

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	8253/8254 timer/ counters	5
8	ADC and DAC cards	5
9	AC & DC motor with Controllers	5
10	Traffic Light Control Systems	5

Course Outcomes (CO)	
CO1	Ability to perform basic programming using 8085 and 8051
CO2	Ability to perform interfacing of various peripheral ICs using 8085 & 8051
CO3	Ability to program basic interfacing applications.
CO4	Ability to use basic Simulators/Emulators/open source related to 8085 & 8051.
CO5	Ability to design and develop a simple application using any embedded processors.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	2	1	1	1	1	1	1	1	1	1	3	2	2	1
CO2	3	2	2	2	2	2	2	1	1	1	1	3	2	3	2
CO3	3	2	3	2	2	1	2	1	1	1	1	3	2	3	2
CO4	3	2	2	2	3	2	1	1	1	1	1	3	2	3	2
CO5	3	2	3	3	3	3	3	3	3	3	3	3	3	3	3

EI1507	**INDUSTRIAL INSTRUMENTATION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

1.	Measurement of speed, torque and vibration parameters.
2.	Calibration of pressure gauge using dead weight tester.
3.	Measurement of level using Differential Pressure Transmitter

4.	Measurement of flow using a. Discharge coefficient of orifice plate b. Calibration of Rotameter
5.	Design and Testing of Electromagnetic Flow meters.
6.	Measurement of Conductivity, Moisture and Viscosity of test solutions.
7.	Standardization and measurement of pH values of different solutions
8.	Measurement and analysis of ECG signals.
9.	Vacuum pressure measurement
10.	Pulse rate measurement
11.	Measurement of Absorbance and Transmittance of Test solutions using IR-spectrometer.
12.	Measurement of Absorbance and Transmittance of Test solutions using UV-spectrometer.
	TOTAL: 60 PERIODS

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
8.	IR – Visible spectrophotometer 1
9.	pH meter 1
10.	Conductivity meter 1
11.	ECG trainer 1
12.	Pulse rate trainer 1
13.	Tacho meter-1

COURSE OUTCOMES (COs)

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	0	0	0	0	0	0	0	0	1	1	0	0	2	0	0
CO2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
CO3	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0
CO4	0	0	0	0		0	0	0	0	0	0	0	0	0	0
CO5	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

SEMESTER VI

EI1601	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To educate various embedded processors.
•	To impart an adequate knowledge of timers and interrupts.
•	To learn embedded C programs.
•	To learn simple embedded applications.
•	To learn IoT using Arduino/Raspberry Pi /open platform

UNIT I	8-BIT EMBEDDED CONTROLLERS AND C PROGRAMMING	9
8-Bit Microcontroller – Architecture – Instruction Set and Programming – Programming Parallel Ports – Timers and Serial Port – Interrupt handling – Memory And I/O Devices Interfacing – Programming Embedded Systems in C – Need For RTOS – Priority Based Scheduling Policies.		
UNIT II	**IOT AND ARDUINO PROGRAMMING**	**9**
ARM Processor – Introduction to the Concept of IoT Devices – IoT Devices Versus Computers – IoT Configurations – Basic Components – Introduction to Arduino – Types of Arduino – Arduino Toolchain – Arduino Programming Structure – Sketches – Pins – Input/Output From Pins Using Sketches – Introduction to Arduino Shields – Integration of Sensors and Actuators with Arduino.		
UNIT III	**BUILDING IoT WITH RASPBERRY PI**	**9**
Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.		
UNIT IV	**IOT COMMUNICATION AND OPEN PLATFORMS**	**9**
IoT Communication Models and APIs – IoT Communication Protocols – Bluetooth – WiFi – ZigBee – GPS – GSM modules – Open Platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud		
UNIT V	**INDUSTRIAL IOT AND SECURITY**	**9**
Introduction to the Industrial Internet - Networked Control Systems – Network delay modeling - Architecture and design methodologies for developing IoT application for Networked Control Systems – Example using SCADA system - Software Design Concepts - Middleware IIOT platforms- securing the Industrial Internet- Introduction to Industry 4.0.		
		TOTAL :45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

CO1	Understand and compare various embedded processors.
CO2	Design and deploy timers and interrupts.
CO3	Write embedded C programs.
CO4	Design simple embedded applications.
CO5	Design portable IoT using Arduino/Raspberry Pi /open platform

TEXT BOOKS:

1.	Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014.
2.	Adrian McEwen, Hakim Cassimally "Designing the Internet of Things", John Wiley & Sons, 2014.

REFERENCES:

1.	Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
2.	IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
3.	Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", VPT, 2014.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1602	PROCESS CONTROL	L	T	P	C
		3	0	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	12
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**	**12**
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- Standard flow equations for sizing Control Valves – Cavitation and flashing – Control Valve selection.		

UNIT III	**CONTROL ACTIONS**	**12**
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**	**12**
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 –Ratio control, Split range control.		
UNIT V	**MODEL BASED CONTROL SCHEMES**	**12**
Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller –- Three- element Boiler drum level control - Introduction to Multi-loop Control Schemes – Control of Heat Exchanger - Multivariable control strategies-Parametric and Nonparametric Models, State space and Transfer Function Representations and their inter relationships-Case study –Distillation column-P&ID diagram		
	TOTAL :60 PERIODS	

COURSE OUTCOMES

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

CO1	Ability to understand technical terms and nomenclature associated with Process control domain.
CO2	Ability to build models using first principles approach as well as analyze models
CO3	Ability to Design, tune and implement PID Controllers to achieve desired performance for various processes
CO4	Ability to Analyze Systems and design & implement control Schemes for various Processes.
CO5	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, 2 nd 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 SystemsAnalysis 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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	2	3	1	1	1	0	0	0	0	0	0	2	2	0
CO2	1	1	2	1	1	0	0	0	0	0	0	0	2	2	0
CO3	1	1	2	1	1	0	0	0	0	0	0	0	2	2	0
CO4	1	2	1	1	1	1	0	0	0	0	0	0	2	2	0
CO5	1	1	3	1	1	0	0	0	0	0	0	0	2	2	0

EE1671	DIGITAL SIGNAL PROCESSING	L	T	P	C
	(Common to EEE and EIE)	3	0	0	3

Objectives

- Signals, systems, sampling techniques and their mathematical representation.
- Analysis of Discrete time systems like Z-transforms, Discrete Time Fourier transform and its applications.
- Discrete Fourier Transformation, Fast Fourier Transformation technique and their computation.
- Filters and their design procedure for digital implementation.
- Digital Signal Processor and its addressing modes.

UNIT – I INTRODUCTION TO SIGNALS AND SYSTEM **9**

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 **9**

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 **9**

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 **9**

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 **9**

Introduction – Architecture – Features – Instruction Set – Addressing Formats – Functional modes – Introduction to Commercial Digital Signal Processors.

Total Periods: 45

Text Books:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, New Delhi, PHI. 2012.
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.

Reference Books:

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 MATAB', Cengage Learning,2014.
3. B.P.Lathi, 'Principles of Signal Processing and Linear Systems', Oxford University Press, 2010.
4. Taan S. ElAli, 'Discrete Systems and Digital Signal Processing with MatLab', CRC Press, 2009.
5. SenM.Kuo, Woon-Seng S Gan, 'Digital Signal Processors', Architecture, Implementations & Applications', Pearson, 2013.
6. DimitrisG.Manolakis, Vinay K. Ingle, 'Applied Digital Signal Processing', Cambridge, 2012.
7. Emmanuel C. Ifeachor, 'Digital Signal Processing – A Practical Approach', 2nd Edition, Prentice Hall, 2011.

Course Outcomes (CO)

CO1	Acquire knowledge on Signals, systems, sampling techniques & their mathematical representation.
CO2	Understand and analyze the Discrete Time Systems like Z-transforms, Discrete Time Fourier transform and its applications.
CO3	Analyze the transformation techniques & their computation.
CO4	Understand the types of filters and their design procedure for digital implementation.
CO5	Gain knowledge about Digital Signal Processor and its addressing modes.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1
CO2	3	2	2	1	1	1	1	1	1	1	1	1	3	1	1
CO3	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2
CO4	3	2	2	2	1	1	1	1	1	1	1	1	3	3	2
CO5	3	1	1	1	1	1	1	1	1	1	1	1	2	3	1

EE1672	EMBEDDED SYSTEMS (Integrated Lab)	L	T	P	C
	(Common to EIE and EEE)	3	0	1	4

COURSE OBJECTIVES

- Building blocks of Embedded System
- Introduction to Embedded processors
- Bus communication in processors, Input/output interfacing
- Basics of real time operating system
- Real-time applications of an embedded system

Unit-I **INTRODUCTION TO EMBEDDED SYSTEMS** **9**

Introduction to Embedded Systems –Building blocks of Embedded System, Structural units in Embedded processor, selection of processor & memory devices- DMA – Memory management methods- Timer and Counting devices, Watchdog Timer, Oscillator and Reset Circuits-Real Time Clock. Introduction to a brief study on a typical embedded processor.

Unit-II	**INTRODUCTION TO EMBEDDED PROCESSORS**	**9**
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols-RS232 standard – RS422 – RS 485- Inter Integrated Circuits (I2C), Serial Peripheral Interface (SPI), CAN Bus, – USB- Wi-Fi- Bluetooth- Zigbee - need for Device Drivers.		
Unit-III	**EMBEDDED NETWORKING**	**9**
Embedded Networking: Introduction, I/O Device Ports & Buses– Serial Bus communication protocols-RS232 standard – RS422 – RS 485- Inter Integrated Circuits (I2C), Serial Peripheral Interface (SPI), CAN Bus, – USB- Wi-Fi- Bluetooth- Zigbee - need for Device Drivers.		
Unit-IV	**RTOS BASED EMBEDDED SYSTEM DESIGN**	**9**
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Pre-emptive and non-pre-emptive scheduling, Task communication shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance-Polling and interrupt handling mechanism- Overview and comparison of commercial RTOS:VX works- µC/OS-II.		
Unit-V	**EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT**	**9**
Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera.		
	TOTAL (L: 45+P: 30):75 PERIODS	

List of Programming exercises:

1. Study of Embedded processors: PIC and ARM
2. Toggle pins and make an LED glow.
3. Buzzer alarm
4. 3 x 3 keypad matrix and display a key
5. Seven-segment Display
6. A/D conversion
7. D/A conversion
8. Generation of a PWM signal
9. Interface a DC motor and stepper motor
10. Interfacing a temperature sensor
11. ESP-8266 wifi MCU for IOT applications.

List of Equipment, software tools and compilers:

1. PIC 16F877a demonstration board with peripherals
2. ARM cortex board with peripherals
3. Desktops with advanced Pentium processors
4. Proteus software tool
5. Micro c -compiler
6. Keil-compiler

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”, Second Edition, McGraw Hill, 2017.
4.	Embedded Systems Fundamentals with Arm Cortex M Based Microcontrollers: A Practical Approach Paperback – 1 March 2017
5.	PIC microcontroller and Embedded systems Using Assembly and C for PIC18, second edition, 2021.

REFERENCES	
1.	Raj Kamal, 'Embedded Systems-Architecture, Programming, Design', Second Edition, Mc Graw Hill, 2013.
2.	C.R. Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013
3.	Tammy Noergaard, "Embedded Systems Architecture", Second Edition, Newnes, 2012.
4.	Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning, 2009.
5.	Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.

Course Outcomes (CO)

CO1	Ability to understand the basic blocks of an embedded systems.
CO2	Ability to understand the embedded processors and its programming
CO3	Ability to acquire knowledge about the embedded network protocols.
CO4	Ability to understand basics of real time operating system.
CO5	Ability to suggest an embedded system for a given application.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	1	2	1	2	1	1	1	1	1	1	3	1	2	1
CO2	2	1	1	2	3	1	1	1	1	1	1	3	1	2	1
CO3	2	1	2	2	3	1	1	1	3	3	3	3	1	2	1
CO4	2	1	2	3	3	3	2	1	1	1	1	3	2	1	1
CO5	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2

DS1302	OBJECT ORIENTED PROGRAMMING (INTEGRATED LAB)	L	P	T	C
	(Common to EEE, EIE & ICE)	3	0	2	4

Objectives

- To analyze the necessity for Object Oriented Programming paradigm over structured programming and become familiar with the fundamental concepts in OOP like encapsulation, Inheritance and Polymorphism
- To design an object-oriented system, GUI components and multithreaded processes as per needs and specifications
- To provide a Strong foundation for advanced programming using Object Oriented Programming Concepts.

UNIT I **JAVA FUNDAMENTALS** **9 +6**

Programming Language types and paradigms – Object Oriented Programming Concepts- History of Java - Java buzzwords- JVM architecture – Java Source File Structure – Naming Convention – Data Types – Literals in Java- Scope and life time of variables – Operators in Java- Control Statements in Java - Array – String and String Buffer

Lab Component:

1. Write a Java program that prints all real solutions to the quadratic equation $ax^2 + bx + c = 0$. Read in a, b, c and use the quadratic formula. If the discriminate $b^2 - 4ac$ is negative, display a message stating

that there are no real solutions.
2. The Fibonacci sequence is defined by the following rule: The first two values in the sequence are 1 and 1. Every subsequent value is the sum of the two values preceding it. Write a Java program that uses both recursive and non recursive functions to print the nth value in the Fibonacci sequence

UNIT II	OBJECT-ORIENTED PROGRAMMING, INTERFACES AND INHERITANCE	9 + 6

Working with Objects - Implementing Classes - Object Construction - Static Variables and Methods – Packages - Nested Classes – Abstract Class - Interfaces – Static, Default and Private Methods – Local and Anonymous Classes – Inheritance – Extending a class - Object: The Cosmic Superclass – Wrapper classes.

Lab Component:

1. Write a java program to create an abstract class named Shape that contains an empty method named number of Sides ( ). Provide three classes named Trapezoid, Triangle and Hexagon such that each one of the classes extends the class Shape. Each one of the classes contains only the method number of Sides ( ) that shows the number of sides in the given geometrical figures
2. Write a Java program that counts the number of objects created by using static variable

UNIT III	EXCEPTIONS, COLLECTIONS AND STREAMS	9 + 6

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.

Lab Component:

1. Write a Java program to make frequency count of words in a given text
2. Write a Java program to implement a Queue using user defined Exception Handling (also make use of throw, throws.).

UNIT IV	CONCURRENT PROGRAMMING AND GUI PROGRAMMING	9 + 6

Threads – Multithreaded Programming – Thread Creation – Life Cycle – Thread Priorities - Synchronization of Threads - Event Handling: Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes. Swing: Introduction, Limitations of AWT, MVC Architecture, Components, Containers, Exploring Swing Components - Handling menus, Layout Manager – Layout Management types – Border, Grid, Flow, Card and Grid Bag.

Lab Component:

1. Write a Java program that creates three threads. First thread displays “Good Morning” everyone second, the second thread displays “Hello” every two seconds and the third thread displays “Welcome” every three seconds.
2. Write a java Program to create a window when we press
   i. M or m the window displays Good Morning
   ii. A or a the window displays Good After Noon
   iii. E or e the window displays Good Evening N or n the window displays Good Night

UNIT V	JAVA SERVER TECHNOLOGIES AND NETWORK PROGRAMMING	9 + 6

Introduction to Servlet - Servlet Life Cycle - The Servlet API - Developing and Deploying Servlets - Exploring Deployment - Networking Basics – Exploring java.net classes and interfaces, InetAddress,

TCP/IP Client and Server Sockets – Cookies and Datagrams.

Lab Component:

1.Develop a program for executing the remote command using TCP Socket

2. Create a GUI program in java with the following components.

i. A frame with Flow layout.

ii. Add the following components on to the frame.

a) Two Text Field

b) A button with the label display

iii. Allow the user to enter data into the JTextField

iv. When the button is clicked paint the frame by displaying the data entered in the JTextField

Allow the user to properly close the frame

TOTAL : 45 + 30 PERIODS

TEXT BOOKS

1.	Herbert schildt , "The complete reference", 11th Edition, Tata Mc Graw Hill, New Delhi. 2018.
2.	Cay S. Horstmann, "Core Java SE 9 for the Impatient", 2nd Edition, Addison-Wesley,2017.
3.	Paul Deitel, Harvey M. Deitel, "Java How to Program", 11th Edition, Pearson Education, 2018.

REFERENCE BOOKS

1.	T. Budd, "An Introduction to Object Oriented Programming", 3rd Edition, Pearson Education, 2009.
2.	Y. Daniel Liang , "Introduction to Java programming", 7th Edition, Pearson education, 2010.
3.	C Xavier , "Java Programming – A Practical Approach", Tata McGraw-Hill Edition, 2011.
4.	K. Arnold and J. Gosling, "The Java programming language", 3rd Edition, Pearson Education, 2000.

COURSE OUTCOMES

CO1	Understand the fundamental ideas behind the object-oriented approach to programming
CO2	Inculcate concepts of inheritance to create new classes from existing one & Design the classes needed given a problem specification
CO3	Develop and implement java programs with exception handling and various I/O Streams
CO4	A modern coverage of generic programming and concurrent programming that focuses on high-level synchronization constructs
CO5	To know the concept of event handling used in GUI and accessing database using JDBC

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	1	1	2	2	2	1	0	2	1	1	1	2	1	1
CO2	1	1	2	2	1	1	2	0	2	1	1	1	2	1	2
CO3	2	2	2	2	2	2	1	0	2	2	2	1	1	1	2
CO4	1	3	2	2	2	2	1	0	1	1	2	1	3	1	3
C05	2	3	3	2	3	2	1	0	2	1	2	2	1	1	2

EI1608	INSTRUMENTATION SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

•	To obtain adequate knowledge in design of various signal conditioning circuits and instrumentation systems.
•	To impart design knowledge of controller, control valve and transmitter.
•	To acquire the knowledge of piping diagram of industrial standard
•	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 / 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).
	TOTAL: 60 PERIODS

OUTCOMES:

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	3	3	3	0	1	0	0	1	0	0	2	2	2	3
CO2	3	3	3	3	0	1	0	0	1	0	0	2	3	2	3
CO3	3	3	3	3	0	2	0	0	1	0	0	2	3	2	3
CO4	3	3	3	3	0	1	0	0	1	0	0	3	3	3	3
CO5	3	3	3	3	0	1	0	0	1	0	0	3	3	3	3

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

S.NO	List of Equipment
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 1 No. each
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

EI1609	PROCESS CONTROL LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

LIST OF 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	Simulation of PID position and velocity forms
7	Characteristics of Pneumatically Actuated Control Valve (with and without Positioner).
8	Study and control of flow process using Compact Flow Control Unit.
9	Control of Level and Pressure using Process Control Training Plant
10	Design and implementation of ON/OFF Controller for the Temperature Process.
11	Design and implementation of Interacting and non-interacting system
13	Analysis of MIMO systems
14	Design and implementation of Multi-loop PID schemes on the simulatedmodel of a Typical Industrial Process
	TOTAL: 60 PERIODS

OUTCOMES:

1.	Ability to understand and analyze process control engineering problems.
2.	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

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	0	3	0	3	0	0	0	0	1	1	1	2	1	3
CO2	2	0	3	0	3	0	0	0	0	1	1	1	3	0	3
CO3	2	0	3	0	3	0	0	0	0	1	1	1	0	3	3
CO4	2	0	3	0	3	0	0	0	0	1	1	1	0	1	1
CO5	2	0	3	0	3	0	0	0	0	1	1	1	3	3	0

SEMESTER VII

EI1701	COMPUTER CONTROL OF PROCESSES	L	T	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 timeSystem.
- To estimate model parameters from input/output measurements
- To Design Digital Controllers
- To Design Multi-loop and Multivariable Controllers for multivariable system

UNIT I BASICS OF PLC AND PROGRAMMING (LADDER) 9

PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/Counter instructions –Program control instructions – Data manipulation and math instructions – Programming Examples

UNIT II 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 — Controllability and observability of linear time invariant discrete data system–Stability tests of discrete-data system

UNIT III	DIGITAL CONTROLLER DESIGN	9
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 – Modern predictive controller – Fuzzy Logic Controller – Case Studies:- Distillation Column, CSTR and Four-tank system.		
	TOTAL : 45 PERIODS	

COURSE OUTCOMES

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

CO1	Ability to analyze the discrete time systems
CO2	Ability to build models from input-output data
CO3	Ability to design a digital controller
CO4	Ability to design multi-loop controller for multi-variablesystems.
CO5	Ability to design multivariable controller for multi-variablesystems.

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:

REFERENCES

1.	Gopal, M., "Digital Control and State Variable Methods", Tata Mc GrawHill, 2003.
2.	Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, "Process Dynamics andControl", 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 ofIndia, 2008.
5.	Thomas E. Marlin, Process Control — Designing Processes and Controlsystems for Dynamic Performance, Mc-Graw-Hill, 2000.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0
CO2	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0
CO3	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0
CO4	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0
CO5	3	2	1	2	0	0	0	0	0	0	0	0	2	2	0

EI1702	APPLIED SOFT COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	Develop the skills to gain a basic understanding of neural network theory.
•	Understand the advanced neural networks and its applications
•	Understand fuzzy logic and reasoning to handle and solve engineering problem
•	To provide comprehensive knowledge of fuzzy logic control to real time systems
•	Introduce bio inspired algorithms from an engineering perspective

UNIT I	ARTIFICIAL NEURAL NETWORK (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 - Neuro controller for inverted pendulum- Introduction to Neural networks in machine learning & Deep learning		
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 – Washing machine – Automotive – inverted pendulum –fuzzy PID control, Fuzzy based motor control.		
UNIT V	**EVOLUTIONARY COMPUTATION AND SWARM INTELLIGENCE**	**9**
Genetic algorithms: Introduction-genetic algorithm steps-selection, crossover, and mutation, Swarm Intelligence - Particle swarm optimization(PSO) - Firefly algorithm(FA) - Bacterial foraging optimization(BFO)		
TOTAL (L: 45+T: 0): 45 PERIODS		

COURSE OUTCOMES

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

CO1	To understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms, applications and their limitations
CO2	To Understand appropriate learning rules for each of the architectures and learn several neural network paradigms and its applications
CO3	To Comprehend the fuzzy logic and the concept of fuzziness involved in various systems and fuzzy set theory.
CO4	To apply Fuzzy logic concepts to engineering problems
CO5	To understand basics of Evolution algorithm and swarm intelligence

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, 1997.
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.
7.	Kalyanmoy Deb ,"Multi-Objective Optimization using Evolutionary Algorithms" ,Wiley

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	2	2	2	-	-	-	-	-	-	1	2	2	1
CO2	3	3	2	2	2	-	-	-	-	-	-	1	2	2	1
CO3	3	3	3	3	2	-	-	-	-	-	-	1	3	2	1
CO4	2	2	3	3	2	-	-	-	-	-	-	1	3	2	1
CO5	2	2	3	2	2	-	-	-	-	-	-	1	2	2	1

EI1703	INDUSTRIAL DATA NETWORKS	L	T	P	C
		3	0	0	3

COURSE 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	

COURSE OUTCOMES

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

CO1	Ability to define basic concepts of data communication and its importance.
CO2	Ability to explain the various internetworking devices involved in industrial networks
CO3	Ability to explain the various serial communication used in process industries.
CO4	Ability to illustrate, compare & explain the working of HART and Field bus used in process digital communication.
CO5	Ability to summarize the operation of MODBUS, PROFIBUS protocol & its 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. Behrouz Forouzan, 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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	0	0	0	3	3	0	0	0	0	0	0	0	2	2	0
CO2	0	0	0	3	3	0	0	0	0	0	0	0	2	2	0
CO3	0	0	0	3	3	0	0	0	0	0	0	0	2	2	0
CO4	0	0	0	3	3	0	0	0	0	0	0	0	2	2	0
CO5	0	0	0	3	3	0	0	0	0	0	0	0	2	2	0

EI1708	INDUSTRIAL AUTOMATION LABORATORY	L	T	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.	PLC 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
11.	Simulation and implementation of Fuzzy logic Control
12.	Simulation and implementation of ANN Control
	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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	2	2	1	-	1	-	-	2	-	-	2	2	2	1
CO2	2	2	2	1	-	1	-	-	2	-	-	2	2	2	1
CO3	2	2	2	1	-	2	-	-	2	-	-	2	2	2	1
CO4	2	2	2	1	-	1	-	-	2	-	-	2	2	2	1
CO5	2	2	2	1	-	1	-	-	2	-	-	2	2	2	1

PROFESSIONAL ELECTIVE – I (V SEMESTER)

CS1501	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

Objectives

- To understand the protocol layering and physical level communication and to analyze the performance of a network.
- To analyze the contents of Data Link layer packet, based on the layer concept.
- To learn the functions of network layer and the various routing protocols.
- To familiarize the functions and protocols of the Transport layer.
- To know about different application layer protocols.

UNIT - I	**INTRODUCTION AND PHYSICAL LAYER**	**9**
Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.		**CO1**
UNIT - II	**DATA-LINK LAYER & MEDIA ACCESS**	**9**
Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC – PPP – Media Access Control – Wired LANs: Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices.		**CO2**
UNIT - III	**NETWORK LAYER**	**9**
Network Layer Services – IPV4 Addresses – Forwarding of IP Packets – Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms – Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.		**CO3**
UNIT - IV	**TRANSPORT LAYER**	**9**
Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol-Congestion Control Mechanisms-Streaming Control Transmission Protocol.		**CO4**
UNIT - V	**APPLICATION LAYER**	**9**
WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP- Internet Multimedia.		**CO5**
	Total Periods:	**45**

Text Books:

1.	Behrouz A. Forouzan, Data Communications and Networking, Fifth Edition TMH, 2013
2.	William Stallings, Data and Computer Communications, Tenth Edition, Pearson Education, 2014.

Reference Books:

1. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Fifth Edition, Morgan Kaufmann Publishers Inc., 2012
2. Nader F. Mir, Computer and Communication Networks, Second Edition, Prentice Hall, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source Approach, McGraw Hill Publisher, 2011
4. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the

Internet, Sixth Edition, Pearson Education, 2013.

Course Outcomes (CO)	
CO1	Understand the basic layers, functions in computer networks and to evaluate the performance of a network.
CO2	Understand the basics of how data flows from one node to another.
CO3	Analyse and design routing algorithms.
CO4	Understand design goals of Connectionless and Connection oriented protocols.
CO5	Understand the working of various application layer protocols.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**								**Program Specific Outcomes**						
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO2	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO3	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO4	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1
CO5	3	3	3	-	-	-	-	-	-	-	-	-	1	1	1

EC1008	**MEMS AND NEMS**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVES

- To introduce the concepts of micro and nano electromechanical devices
- To know the fabrication process of Microsystems
- To know the design concepts of micro sensors and micro actuators
- To introduce the concepts of quantum mechanics and nano systems

UNIT I	**INTRODUCTION TO MEMS AND NEMS**	**9**
New trends in Engineering and Science: Micro and Nano scale systems. Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.		**CO1**
UNIT II	**MEMS FABRICATION TECHNOLOGIES**	**9**
Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, PECVD, Sputtering, Etching techniques: Dry and wet etching, electrochemical etching, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA.		**CO2**
UNIT III	**MICRO SENSORS**	**9**

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester		**CO3**
UNIT IV	**MICRO ACTUATORS**	**9**
Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch.		**CO4**
UNIT V	**NANO DEVICES**	**9**
Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Marc Madou, ―Fundamentals of Microfabrication, CRC press 1997.
2. Stephen D. Senturia, Micro system Design, Kluwer Academic Publishers, 2001.

REFERENCE BOOKS

1. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata Mcraw Hill, 2002.
2. Chang Liu, ―Foundations of MEMS‖, Pearson education India limited, 2006,
3. Sergey Edward Lyshevski, ―MEMS and NEMS: Systems, Devices, and Structures‖ CRC Press, 2002.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the fundamentals and working principles of micro systems and microelectronics.
CO2	Understand the both micro fabrication and manufacturing techniques.
CO3	Acquire knowledge about micro sensors.
CO4	Study the design and force analysis of micro actuators.
CO5	Study about the basic concepts of nano electronics with various devices and also discusses with its applications.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	2	2	1	3	2	1	1	1	2	2	3	2	1	2
CO2	2	2	2	1	2	3	2	1	1	1	2	3	3	3	1
CO3	2	3	3	2	2	2	1	1	1	2	3	2	2	2	3
CO4	3	2	3	3	3	1	3	1	1	2	2	2	3	2	2
CO5	2	3	3	2	3	2	2	1	1	1	2	2	2	2	2

EE1552	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To obtain the knowledge about Conventional Electrical Vehicles
- To obtain the knowledge about Hybrid Electric Drive and Trains
- To obtain the knowledge about Electric propulsion Unit
- To obtain the knowledge about Energy storage devices and sizing of the drive system
- To obtain the knowledge about Energy Management Techniques

Unit-I	**CONVENTIONAL VEHICLES**	**12**

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance

Unit-II	**HYBRID ELECTRIC DRIVE-TRAINS**	**12**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

Unit-III	**ELECTRIC PROPULSION UNIT**	**12**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit-IV	**ENERGY STORAGE & SIZING THE DRIVE SYSTEM**	**12**

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

Unit-V	**ENERGY MANAGEMENT STRATEGIES**	**12**

Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV)

TOTAL :60 PERIODS

COURSE OUTCOMES	
At the end of the course, the student should have the:	
CO1	Ability to understand about Commercial Vehicles
CO2	Ability to get knowledge about Hybrid and Electric Trains
CO3	Ability to understand about Electric Propulsion Unit
CO4	Ability to understand the principles of Energy storage and drive systems
CO5	Ability to nderstand about Energy Management Techniques
TEXT BOOKS	
1.	Iqbal Hussein,,"Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003
REFERENCES	
1.	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004
2.	James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003
3.	Ebrahimi, Kambiz M., Ehsani, Mehrdad, Gao, Yimin, Longo, Stefano, Modern electric, hybrid electric, and fuel cell vehicles,CRC Press,2018

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	2	2	1	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	1	-	-	-	-	-	-	-	2	1	-
CO3	3	3	3	3	1	-	-	-	-	-	-	-	3	2	-
CO4	3	3	3	3	1	-	-	-	-	-	-	-	2	2	-
CO5	3	3	3	2	1	-	-	-	-	-	-	-	2	2	-

EI1511	ANALYTICAL INSTRUMENTATION	L	T	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 – Attenuated total reflectance flame photometers - Atomic absorption spectrophotometry – Fluorescence Spectrophotometer Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.		
UNIT II	**CHROMATOGRAPHY**	**9**
General principles – chromatographic behaviour of solutes – quantitative determination – Techniques by chromatographic bed shape- Column chromatography-Planar Chromatography - Paper Chromatography-Thin layer Chromatography-Applications - Techniques by physical state of mobile phase- Gas chromatography – Sources - Detectors – Liquid chromatographs – sources- detectors- Applications – High-pressure liquid chromatographs – sources-detectors- Applications- Techniques by separation mechanism-Ion exchange chromatography-size-exclusion chromatography-Applications.		
UNIT III	**INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS**	**9**
Gas analyzers – Oxygen, NO2 and H2S 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**
Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors, 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 – Electron spin Resonance spectroscopy – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES

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

CO1	Ability to understand the fundamental principles of selective analytical instruments used in medical diagnosis, quality assurance & control and research studies.
CO2	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.
CO3	Ability to critically evaluate the strengths and limitations of the various instrumental methods.
CO4	Ability to develop critical thinking for interpreting analytical data.
CO5	Ability to understand the working principle, types and applications of NMR and Mass spectroscopy

TEXT BOOKS

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.

REFERENCES

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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	0	0	0	3	2	2	0	0	0	0	0	0	2	2	0
CO2	0	0	0	3	2	2	0	0	0	0	0	0	2	2	0
CO3	0	0	0	3	2	2	0	0	0	0	0	0	2	2	0
CO4	0	0	0	3	2	2	0	0	0	0	0	0	2	2	0
CO5	0	0	0	3	2	2	0	0	0	0	0	0	2	2	0

EI1512	MODERN CONTROL THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To explain the concepts of basic and modern control system for the real time analysis and design of control systems.
•	To explain the concepts of state variables analysis.
•	To study and analyze non-linear systems.
•	To analyze the concept of stability for nonlinear systems and their categorization.
•	To apply the comprehensive knowledge of optimal theory for Control Systems.

UNIT I	MATHEMATICAL PRELIMINARIES AND STATE VARIABLE ANALYSIS	9
Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen values, Eigen Vectors and a Canonical form representation of Linear systems – The concept of state – State space model of Dynamic systems – Time invariance and Linearity – Non uniqueness of state model – State diagrams for Continuous-Time State models – Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and properties. Complete solution of state space model due to zero input and due to zero state.		
UNIT II	**CONTROLLABILITY AND OBSERVABILITY**	**9**
General concept of controllability – Controllability tests, different state transformations such as diagnolization, Jordon canonical forms and Controllability canonical forms for Continuous-Time Invariant Systems – General concept of Observability – Observability tests for Continuous-Time Invariant Systems – Observability of different State transformation forms.		
UNIT III	**STATE FEEDBACK CONTROLLERS AND OBSERVERS**	**9**
State feedback controller design through Pole Assignment, using Ackkermans formula– State observers: Full order and Reduced order observers.		
UNIT IV	**NON-LINEAR SYSTEMS**	**9**
Introduction – Non Linear Systems – Types of Non-Linearities – Saturation – Dead-Zone – Backlash – Jump Phenomenon etc; Linearization of nonlinear systems, Singular Points and its types– Describing function–describing function of different types of nonlinear elements, – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, Stability analysis of nonlinear systems based on phase-plane method.		

UNIT V	**STABILITY ANALYSIS**	**9**
Stability in the sense of Lyapunov, Lyapunov's stability, and Lypanov's instability theorems – Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method.		
TOTAL : 45 PERIODS		

COURSE OUTCOMES

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

CO1	To perform state variables analysis for any real time system.
CO2	Apply the concept of optimal control to any system.
CO3	Able to examine a system for its stability, controllability, and observability.
CO4	Implement basic principles and techniques in designing linear control systems.
CO5	Formulate and solve deterministic optimal control problems in terms of performance indices.

TEXT BOOKS

1.	M. Gopal, Modern Control System Theory by – New Age International – 1984
2.	Ogata. K, Modern Control Engineering by– Prentice Hall – 1997
3.	N K Sinha, Control Systems– New Age International – 3rd edition

REFERENCES

1.	Donald E. Kirk, Optimal Control Theory an Introduction, Prentice – Hall Network series – First edition.
2.	William L Brogan, Modern Control theory, Pearson, Third Edition, 1990.
3.	Richard Dorf, Robert Bishop, Modern Control Systems, Pearson, Global Edition, 2017.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1	2	1	2	0	0	0	0	1	0	0	2	2	0	1
CO2	1	2	1	1	2	0	0	0	1	0	0	2	2	0	1

CO3	2	2	1	1	1	0	0	0	1	0	0	2	2	0	2
CO4	2	1	1	1	1	0	0	0	1	0	0	2	2	0	2
CO5	1	2	1	1	1	0	0	0	1	0	0	2	2	0	1

EI1513	INSTRUMENTATION STANDARDS	L	T	P	C
		2	**2**	**0**	**3**

COURSE OBJECTIVES

- To impart basic knowledge on Instrumentation standards

UNIT I	**STANDARDS ORGANIZATION**	**9**
Standards: Introduction International and National Standards organization: IEC, ISO, NIST, IEEE, ISA, API, BIS, DIN, JISC and ANSI. API: Process Measurement and Instrumentation (APIRP551): recommended practice for installation of the instruments – flow, level, temperature, pressure - Process Instrument and Control (API RP554): performance requirements and considerations for the selection, specification, installation and testing of process instrumentation and control systems		
UNIT II	**ISA STANDARDS**	**9**
Documentation of Measurement and Control, Instruments and System (ISA 5): 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7 - General Requirements for Electrical Equipment in Hazardous Location (ISA 12): 12.2, 12.4, 12.24, 12.29 – Instrument Specification Forms (ISA20): – Measurement Transducers (ISA37)		
UNIT III	**ISA STANDARDS - CONTROL VALVE AND ACTUATOR**	9
Control Valve Standards (ISA75): 75.01, 75.04, 75.05, 75.7, 75.11, 75.13, 75.14, 75.23, 75.24,75.26. Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04.		
UNIT IV	**ISA STANDARDS - FOSSIL AND NUCLEAR POWER PLANTS**	**9**
Fossil Power Plant Standards (ISA 77): 77.14, 77.22, 77.30, 77.41, 77.42, 77.44, 77.60, 77.70. Nuclear Power Plant Standards (ISA67): 67.01, 67.02, 67.03, 67.04, 67.06.		
UNIT V	**BS , ISO, IEC, & ANSI**	**9**
Measurement of Fluid Flow by means of Orifice Plates (ISO 5167/ BSI042) IEC 61131-3 – Programmable Controller – Programming Languages – Specification for Industrial Platinum Resistance Thermometer Sensors (BSI904) – International Thermocouple Reference Tables (BS4937) – Temperature Measurement Thermocouple (ANSIC96.1)		
		TOTAL :45 PERIODS

COURSE OUTCOMES

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

CO1	Ability to understand the role of standards organization
CO2	Ability to interpret and follow different standards while carrying out installation of sensors, transmitters, Industrial automation systems, PLC programming, documentation, equipment selection in hazardous area and instrument specification forms
CO3	Ability to understand and follow different standards while performing control valve sizing, actuator sizing and orifice sizing etc
CO4	Ability to interpret and follow different standards while carrying out monitoring and control of fossil fuel power plants and nuclear power plants.
CO5	Ability to understand BS , ISO, IEC, & ANSI

TEXT BOOKS

1.	API Recommended Practice 551, "Process Measurement Instrumentation", American Petroleum Institute, Washington, D.C., 1st Edition, May 1993
2.	API Recommended Practice 554, "Process Instrumentation and Control – 3 parts", American Petroleum Institute, Washington, D.C., 1st Edition, October 2008.
3.	ISA standard 5, "Documentation of Measurement and Control Instruments and Systems", ISA, North Carolina, USA
4.	ISA standard 12, "Electrical Equipment for Hazardous Locations", ISA, North Carolina, USA.
5.	ISA standard 20, "Instrument Specification Forms", ISA, North Carolina, USA
6.	ISA standard 37, "Measurement Transducers", ISA, North Carolina, USA.
7.	ISA standard 75, "Control Valve Standards", ISA, North Carolina, USA.
8.	ISA standard 96, "Valve Actuator", ISA, North Carolina, USA.
9.	ISA standard 77, "Fossil Power Plant Standards", ISA, North Carolina, USA
10.	ISA standard 67, "Nuclear Power Plant Standards", ISA, North Carolina, USA
11.	BS EN 60584-1, "Thermocouples - EMF specifications and tolerances", British Standard, 2013

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course	Program Outcomes	Program Specific

Outcomes													Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	0	0	2	2	0	0	0	0	0	2	2	0
CO2	1	0	1	0	2	2	2	0	0	0	0	0	2	2	0
CO3	1	1	2	0	2	2	1	0	0	0	0	0	2	2	0
CO4	1	1	1	0	1	2	2	0	0	0	0	0	2	2	0
CO5	1	1	2	0	2	1	2	0	0	0	0	0	2	2	0

PROFESSIONAL ELECTIVE – II (VI SEMESTER)

EI1621	PROCESS DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Experimental Design
- Linear Regression Analysis
- Linear Model Selection and Regularization
- Classification
- Process Identification, Performance Monitoring and Soft Sensor Design
-

Unit-I	INTRODUCTION	9

Introduction to Process data analytics and Statistical learning - Review of Linear Algebra Concepts – Review of Probability & Statistics - Design of experiments - Industrial case studies on factorial experiments.

Unit-II	REGRESSION	9

Linear Regression:- Simple Linear Regression, Multiple Linear Regression -K-nearest neighbours regression – Practical Consideration in the Regression Model - Validation methods to assess model quality:-The validation set approach, Leave-One-Out Cross Validation, k-Fold Cross Validation – Bias-variance Trade-off for k-Fold Cross Validation.-**Python Programming**

Unit-III	LINEAR MODEL SELECTION & REGULARIZATION	9

Subset Selection: - Best Subset Selection, Step-wise Selection and Choosing the Optimal Model – Shrinkage Methods: - LASSO, Ridge regression, Elastic nets – Dimension reduction Methods:- Principal Components Regression, Partial Least Squares. .-**Python Programming**

Unit-IV	SUPERVISED LEARNING WITH REGRESSION AND CLASSIFICATION TECHNIQUES	9

Logistic regression– Linear Discriminant Analysis - Quadratic Discriminant Analysis –Regression & Classification Trees – Support Vector Machines - Random forests, Bagging and boosting -Deep Learning. .-**Python Programming**

Unit-V	**APPLICATIONS**	**9**
Process data analysis for system identification (under open and closed loops) – Controller Performance Monitoring - Principal components analysis (PCA) for Process Monitoring and Partial Least Squares (PLS) for soft-sensor design - Data-based causality analysis for identification of process topology. .- **Python Programming**		
	TOTAL :45 PERIODS	

COURSE OUTCOMES

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

CO1	Be able to apply Design of Experiments for Problem solving and Process Troubleshooting
CO2	Be able to select the right choice of regression method for a given application.
CO3	Be able to select the right choice of classification method for a given application.
CO4	Be able to systematically carryout System Identification, Process & Performance Monitoring.
CO5	Be able to cohesively analyze alarm data, process data and process connectivity information

REFERENCES

1.	Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer Texts in Statistics, 2013.
2.	Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 2013
3.	Thomas A. Runkler, Data Analytics: Models and Algorithms for Intelligent Data Analysis, Springer Vieweg, 2nd Edition, 2016.
4.	Arun K. Tangirala, Principles of System Identification – Theory and Practice, CRC Press, 2018.
5.	Huang, B. and Shah, S.L., Performance Assessment of Control Loops: Theory and Applications, Springer-Verlag,2007.
6.	Fan Yang, Ping Duan, Sirish L Shah, Tongwen Chen, Capturing Connectivity and Causality in Complex Industrial Processes, Springer, 2014.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	3	0	0	0	0	1	1	0	0	1	2	2	0	1
CO2	2	2	0	0	0	0	1	1	0	0	1	2	2	0	1

CO3	2	1	0	0	0	0	1	1	0	0	1	2	2	0	1
CO4	2	3	0	0	0	0	1	1	0	0	1	2	2	0	1
CO5	2	3	0	0	0	0	1	1	0	0	1	2	2	0	1

EE1731	SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- The concept of system identification and adaptive control.
- Black-box approach-based system identification.
- Batch and recursive identification.
- Computer Controlled Systems.
- Design concept for adaptive control schemes.

UNIT - I	**NON-PARAMETRIC METHODS**	**9**
Non-parametric methods - Transient analysis - frequency analysis - Correlation analysis - Spectral analysis - Input signal design for identification.		**CO1**
UNIT - II	**PARAMETRIC METHODS**	**9**
Least squares estimation - Analysis of the least squares estimate - Best linear unbiased estimate - Model parameterizations - Prediction error methods.		**CO2**
UNIT - III	**RECURSIVE IDENTIFICATION METHODS**	**9**
The recursive least square method - Model validation - Model structure determination, Introduction to closed loop system identification of the Cell - series and parallel connections, maximum power point tracking, Applications.		**CO3**
UNIT - IV	**ADAPTIVE CONTROL SCHEMES**	**9**
Introduction – Auto-tuning of PID controller using relay feedback approach – Types of adaptive control, Gain scheduling, Model reference adaptive control, Self–tuning controller – Design of gain scheduled adaptive controller – Applications of gain scheduling.		**CO4**
UNIT - V	**MODEL-REFERENCE ADAPTIVE SYSTEM (MRAS) and SELF-TUNING REGULATOR (STR)**	**9**
STR – Pole placement design – Indirect STR and direct STR, MRAC - MIT rule – Lyapunov theory – Relationship between MRAC and STR.		**CO5**
	Total Periods:	**45**

Text Books:

1. T. Soderstrom and PetreStoica, System Identification, Prentice Hall International (UK) Ltd. 1988.
2. Karl J. Astrom and Bjorn Witten mark, Adaptive Control, Addison-Wesley, 2016.

Reference Books:

1. L. Ljung, System Identification - Theory for the User, 2nd Edition, Pearson education, 1999.
2. K. S. Narendra and A. M. Annaswamy, Stability Adaptive Systems, Dover Publications, 2005.
3. H. K. Khalil, Nonlinear Systems, Pearson education, 3rd Edition, 2002.
4. William S.Levine, "Control Systems Advanced Methods, the Control Handbook,2nd Edition, CRC Press, 2010.
5. S. Sastry and M. Bodson, Adaptive Control, Prentice-Hall, 1988.

Course Outcomes (CO)

CO1	Ability to understand various system identification techniques and features of adaptive control like STR and MRAC.
CO2	Ability to understand the concept of system identification and adaptive control.
CO3	Ability to understand about Black-box approach-based system identification.
CO4	Ability to get knowledge about batch and recursive identification, Ability to design concept for adaptive control schemes.
CO5	Ability to study about computer-controlled systems.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

EI1622	ADVANCED INSTRUMENTATION SYSTEMS	L	T	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 (L: 45): 45 PERIODS

COURSE OUTCOMES

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

CO1	Able to understand the instrumentation behind flow, level, temperature and pressure measurement
CO2	Able to acquire basic knowledge on the various types of analyzers used in typical industries.
CO3	Able to understand the role of Safety instrumented system in the industry.
CO4	Able to explain Standards for applying Instrumentation in Hazards Locations.
CO5	Able to design, develop, and interpret the documents used to define instruments and control

TEXT BOOKS

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

REFERENCES

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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	0	2	2	0	0	1	0	0	1	1	2	3	1	2
CO2	2	0	2	2	0	0	1	0	1	1	1	2	3	2	1
CO3	2	0	2	2	0	0	1	0	0	1	1	2	3	1	1
CO4	2	0	2	2	0	0	1	1	0	1	1	2	2	3	1
CO5	2	0	2	2	0	0	1	1	1	1	1	2	2	3	1

EE1853	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

Objectives

To impart knowledge about the following topics:

- Architecture and programming model of PIC microcontroller.
- Interrupts and timers in PIC microcontroller.
- Various communication buses for data transfer and I/O interfacing.
- Architecture and programming model of ARM processor.
- ARM Organisations and embedded ARM applications.

UNIT - I	INTRODUCTION TO PIC MICROCONTROLLER	9
Introduction to PIC Microcontroller; PIC 16C6x and PIC16C7x Architecture, Pipelining - Program Memory considerations, Register File Structure, Instruction Set , Addressing modes, Simple Operations.		**CO1**

UNIT - II	INTERRUPTS AND TIMER	9
PIC micro controller Interrupts; External Interrupts, Interrupt Programming; Loop time subroutine Timers, Timer Programming; Front panel I/O, Soft Keys, State machines and key switches, Display of Constant and Variable strings.		**CO2**

UNIT - III	PERIPHERALS AND INTERFACING	9

I^2C Bus for Peripherals Chip Access: Bus operation;Bus subroutines; Serial EEPROM; Analog to Digital Converter; Digital to Analog converter; UART- Baud rate selection; Data handling circuit- Initialization; LCD and keyboard Interfacing ; Sensor Interfacing.	**CO3**

UNIT - IV	**INTRODUCTION TO ARM PROCESSOR**	**9**
Architecture, ARM programmer's model, ARM Development tools, Memory Hierarchy ,ARM Assembly Language Programming, Simple Examples, Architectural Support for Operating systems.		**CO4**

UNIT - V	**ARM ORGANIZATION**	**9**
3-Stage Pipeline ARM Organization; 5-Stage Pipeline ARM Organization; ARM Instruction Execution; ARM Implementation; ARM Instruction Set; ARM coprocessor interface; Architectural support for High Level Languages; Embedded ARM Applications.		**CO5**

Total Periods:	**45**

Text Books:

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication,2nd edition, 2015.

Reference Books:

1. Mazidi, M.A.,"PIC Microcontroller" Rollin Mckinlay, Danny causey ,Prentice Hall of India, 2007.

Course Outcomes (CO)

CO1	Ability to understand the concepts of Architecture of PIC microcontroller
CO2	Ability to acquire knowledge on Interrupts and timers.
CO3	Ability to understand the importance of Peripheral devices for data communication and to understand the basics of sensor interfacing
CO4	Ability to acquire knowledge in Architecture of ARM processors
CO5	Ability to acquire knowledge on ARM Organization in embedded ARM application.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	3	3	3	2	1	1	1	2	1	3	2	3	3
CO2	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3
CO3	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3
CO4	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3
CO5	3	3	3	3	3	2	1	1	1	2	1	3	3	3	3

EI623	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE 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-Gradient methods-I-II order edge detectors, 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 & MPEG standard- Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns		
		TOTAL : 45 PERIODS

COURSE OUTCOMES

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

CO1	Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
CO2	Operate on images using the techniques of smoothing, sharpening and enhancement.

CO3	Understand the restoration concepts and filtering techniques.
C04	Learn the basics of segmentation, features extraction, compression and recognition methods for color models.
CO5	Understand different methods of compressing an image for effective storage and retrieval

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	1	2	2	-	-	-	-	1	-	-	1	3	2	1
CO2	3	1	2	2	-	-	-	-	1	-	-	1	3	2	1
CO3	3	1	2	2	-	-	-	-	1	-	-	1	3	2	1
CO4	3	1	2	2	-	-	-	-	1	-	-	1	3	2	1
CO5	3	1	2	2	-	-	-	-	1	-	-	1	3	2	1

EI1624	**FIBRE OPTICS AND LASER INSTRUMENTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

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,– fibre characteristics: 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

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

CO1	Understand the principle, transmission, dispersion and attenuation characteristics of opticalfibers
CO2	Apply the gained knowledge on optical fibers for its use as communication medium
CO3	To educate sensor as well which have important applications in production, manufacturing industrial and biomedical applications.
CO4	Understand laser theory and laser generation system
CO5	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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	0	3	0	0	0	0	0	0	0	0	0	2	2	0
CO2	3	0	3	0	0	0	0	0	0	0	0	0	2	2	0
CO3	3	0	3	0	0	0	0	0	0	0	0	0	2	2	0
CO4	3	0	3	0	0	0	0	0	0	0	0	0	2	2	0
CO5	3	0	3	0	0	0	0	0	0	0	0	0	2	2	0

PROFESSIONAL ELECTIVE – III (VII SEMESTER)

EI1731	OPTIMAL CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To understand the optimal control concepts and its importance.
•	To study the important optimal control methods existing in the industries in order obtain therequired 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	9
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**	**9**
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**	**9**
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**	**9**
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**	**9**
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 (L: 45+T: 30): 75 PERIODS

COURSE OUTCOMES

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

CO1	Problem formulation, forms of optimal control and its necessary conditions.
CO2	Solving the algebraic equations to design the controller and to study about various problems
CO3	Designing optimal controllers using a class of procedures
CO4	Predict the system dynamic behavior through solution of ODEs and formation of optimalcontrol problem
CO5	Solve equations to design the controllers in discrete methods representing spatial and temporal variations in physical systems through numerical methods.

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.	Gopal M, "ModernControlSystemTheory," NewAgeInternational
4.	Sage. A.P.&White, C.C., "Optimum Systems Control," PrenticeHall, 1977.
5.	http://nptel.ac.in/courses/108105019/

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-

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

EI1732	**LOGIC AND DISTRIBUTED CONTROL SYSTEM**	**L**	**T**	**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)

CO1	Ability to understand all the important components such as PLC, SCADA, DCS,
CO2	To understand I/O modules and field devices of an industrial automation system
CO3	Ability to develop PLC program in different languages for industrial sequential applications
CO4	Able to select and use most appropriate automation technologies for a given application.
CO5	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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	2	1	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	3	2	-
CO4	2	2	3	3	2	-	-	-	-	-	-	-	2	2	-

CO5	2	2	3	2	1	-	-	-	-	-	-	-	2	2	-

EI1733	ADVANCED TOPIC IN PID CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To provide an overview of the features associated with Industrial type PID controller.
•	To make the students understand the various PID Controller Design methods and about PID stabilization for Linear Time-invariant models.
•	To develop the skills needed to design adaptive and non-linear PID 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.

UNIT I	INTRODUCTION	9
Evolution of PID controller – PID Controller Structures – PID Implementation Issues – Tuning of PIDController using Classical Approaches.		
UNIT II	**PID CONTROLLER DESIGN**	**9**
PID Controller Design Techniques : Pole placement, Lamda Tuning, Direct Synthesis, Gain Margin & Phase Margin and Optimization methods - Auto-Tuning.		
UNIT III	**PID STABILIZATION**	**9**
Stabilization of Linear Time-invariant Plants using P/PI/ PID controllers – Optimal Design using PIDControllers – Robust and Non-fragile PID Controller Design.		
UNIT IV	**ADAPTIVE/NON-LINEAR PID CONTROL SCHEMES**	**9**
Gain Scheduled PID Controller - Self-tuning PI/PID Controller – PID Types Fuzzy Logic Controller – Predictive PID Control.		
UNIT V	**INTRODUCTION TO FRACTIONAL ORDER SYSTEM AND FRACTIONAL ORDER PID CONTROLLER**	**9**
Fractional-order Calculus and Its Computations — Frequency and Time Domain Analysis of Fractional-Order Systems - Filter Approximations to Fractional-Order Differentiations –Model reduction Techniques for Fractional Order Systems – Fractional Order PI/PID Controller Design.		
		TOTAL (L: 45): 45 PERIODS

COURSE OUTCOMES

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

CO1	Ability to determine the advanced Features supported by the Industrial Type PID Controller.
CO2	Ability to Design, tune and implement P/PI/PID Controllers to achieve desired Performance forvarious processes.
CO3	Ability to design and implement adaptive PID controllers and Non-linear PID Control schemes.
CO4	Ability to Analyze Fractional-order systems, Fractional-order- controller
CO5	Design of controller for fractional order systems.

TEXT BOOKS

1.	Karl J. Astrom and Tore Haggland, "Advanced PID Control", ISA Publications, 2005.
2.	Aniruddha Datta, Ming-Tzu Ho, and Shankar P. Bhattacharyya, "Structure and Synthesis of PID Controllers", Advances in Industrial Control, Springer Verlag London, 2000.

REFERENCES

1.	Antonio Visioli, "Practical PID Control" Springer- Verlag London, 2006.
2.	Aidan O' Dwyer, "Handbook of PI and PID Controller Tuning Rules", Imperial College Press, 2009.
3.	Xue, D., Chen, Y.Q., and Atherton, D.P., "Linear Feedback Control Analysis and Design with MATLAB, Advances in Design and Control", Society for Industrial and Applied Mathematics, 2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1734	MODEL PREDICTIVE CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To teach the students the general principles of model predictive control scheme.
•	To provide a comprehensive description of model predictive control schemes namely as dynamic matrix control, generalized predictive control scheme and State space based model predictive control scheme.
•	To highlight the key features of MPC for its Industrial Success.
•	To introduce the skills required to formulate both unconstrained and constrained optimal control schemes.
•	To develop the skills needed to design Model Predictive Control schemes to achieve the desired performance.

UNIT I	MODEL PREDICTIVE CONTROL SCHEMES	9
Introduction to Model Predictive Control - Model Predictive Control Elements - Model Predictive Control Schemes: Dynamic Matrix Control and Model Algorithmic Control – Case Studies.		
UNIT II	**GENERALIZED PREDICTIVE CONTROL SCHEME**	**9**
Generalized Predictive Control Scheme – Simple Implementation of Generalized Predictive Control Scheme for Industrial Processes – Multivariable Generalized Predictive Control Scheme – Case Studies.		
UNIT III	**STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME**	**9**
State Space Model Based Predictive Control Scheme - Review of Kalman Update based filters – State Observer Based Model Predictive Control Schemes – Case Studies.		
UNIT IV	**CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME**	**9**
Constraints Handling: Amplitude Constraints and Rate Constraints – Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.		
UNIT V	**ADVANCED TOPICS IN MPC**	**9**
Robust Model Predictive Control Scheme – Adaptive Model Predictive Control Scheme – Multiple- Model based Model Predictive Control Scheme - Fast Methods for Implementing		

Nonlinear Model Predictive Control Scheme — Case Studies
TOTAL (L: 45): 45 PERIODS

COURSE OUTCOMES

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

CO1	Ability to explain the advantages and disadvantages of various MPC schemes
CO2	Ability to design both unconstrained and constrained model predictive controllers.
CO3	Ability to explain the advanced Features supported by the MPC Scheme.
CO4	Ability to Identify, formulate and solve problem in the field of Process Control domain using MPC.
C05	Ability to implement MPC algorithms in MATLAB/SCILAB.

TEXT BOOKS

1.	Camacho, E.F., and Bordons, C., "Model Predictive Control", 2nd Edition, Advanced in Industrial Control Springer Verlag, 2013.
2.	Liuping Wang, "Model Predictive Control System Design and Implementation Using MATLAB",Advanced in Industrial Control, Springer Verlag, 2009.

REFERENCES

1.	Wayne Bequette, B., "Process Control: Modeling, Design, and Simulation", Prentice Hall of India, 2004.
2.	Seborg, D.E., Duncan, A. Mellichamp , Edgar,T.F., and Doyle,F.J., III, "Process Dynamics and Control", John Wiley and Sons, 3rd Edition, 2010.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1735	FAULT DETECTION AND DIAGNOSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To give an overview of different Fault Detection and Diagnosis methods.
•	To present an overview of various types of fault detection schemes using Limit Checking, Parameter estimation methods, Principle Component Analysis.
•	To impart knowledge and skills needed to design and detect sensor and actuators faults using structured residual approach as well as directional structured residual approach.
•	To impart knowledge and skills needed design and detect faults in sensor and actuators using GLR and MLR based Approaches.
•	To impart knowledge and skills needed to detect and quantify and compensate stiction in Control valves.

UNIT I	INTRODUCTION & ANALYTICAL REDUNDANCY CONCEPTS	9
Introduction – Types of faults and different tasks of Fault Diagnosis and Implementation – Different approaches to FDD: Model free and Model based approaches-Introduction-Mathematical representation of Faults and Disturbances: Additive and Multiplicative types – Residual Generation: Detection, Isolation, Computational and stability properties – Design of Residual generator – Residual specification and Implementation.		
UNIT II	**FAULT DETECTION AND DIAGNOSIS USING LIMIT CHECKING AND PROCESS IDENTIFICATION METHODS**	**9**
Limit Checking of absolute values – Trend Checking – Change detection using binary thresholds – adaptive thresholds – Change detection with Fuzzy thresholds – Fault detection using Process Identification methods and Principle Component Analysis.		
UNIT III	**FAULT DETECTION AND DIAGNOSIS USING PARITY EQUATIONS**	**9**
Introduction — Residual structure of single fault Isolation: Structural and Canonical structures-Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts — Introduction to parity equation implementation and alternative representation - Directional Specifications: Directional specification with and without disturbances — Parity Equation Implementation.		
UNIT IV	**FAULT DIAGNOSIS USING STATE ESTIMATORS**	**9**
Introduction – Review of State Estimators – Fault Detection and Diagnosis using Generalized		

Likelihood Ratio Approach and Marginalized Likelihood Ratio Approach.		
UNIT V	**CASE STUDIES**	**9**
Fault detection and diagnosis of DC Motor Drives – Fault detection and diagnosis of a Centrifugal pump-pipe system – Fault detection and diagnosis of an automotive suspension and the tire pressures - Automatic detection, quantification and compensation of valve stiction.		
TOTAL (L: 45): 45 PERIODS		

COURSE OUTCOMES

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

CO1	Ability to explain different approaches to Fault Detection and Diagnosis.
CO2	Ability to detect faults using Limit Checking, Parameter estimation methods, Principle ComponentAnalysis.
CO3	Ability to design and detect sensor and actuators faults using structured residual approach aswell as directional structured residual approach.
CO4	Ability to design and detect faults in sensor and actuators using GLR and MLR based Approaches.
C05	Ability to detect and quantify and compensate stiction in Control valves.

TEXT BOOKS

1.	Janos J. Gertler, "Fault Detection and Diagnosis in Engineering systems", 2nd Edition, Marcel Dekker, 1998.
2.	Rolf Isermann, "Fault-Diagnosis Systems an Introduction from Fault Detection to Fault Tolerance", Springer Verlag, 2006.

REFERENCES

1.	Steven X. Ding, "Model based Fault Diagnosis Techniques: Schemes, Algorithms, and Tools",Springer Publication, 2012.
2.	Hassan Noura, Didier Theilliol, Jean-Christophe Ponsart and Abbas Chamseddine, "Fault- Tolerant Control Systems: Design and Practical Applications", Springer Publication, 2009.
3.	Mogens Blanke, "Diagnosis and Fault-Tolerant Control", Springer, 2006.
4.	Ali Ahammad Shoukat Choudhury, Sirish L. Shah and Nina F. Thornhill, "Diagnosis of Process Nonlinearities and Valve Stiction: Data Driven Approaches", Springer, 2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1736	SAFETY INSTRUMENTAL SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.
- To make the students understand different layers of protection.
- To make student conscious about safety instrumentation applications.
- To make the students aware of potential events and impact of failures.
- To make students aware of design, installation and maintenance procedures.

UNIT I INTRODUCTION **9**

Safety Instrumented System (SIS): need, features, components, difference between basic process control system and SIS - Risk: how to measure risk, risk tolerance, Safety integrity level, safety instrumented functions - Standards and Regulation – HSE-PES, AICHE-CCPS, IEC-61508, ANSI/ISA-84.00.01-2004 (IEC 61511 Mod) & ANSI/ISA – 84.01-1996, NFPA 85, API RP 556, API RP 14C, OSHA (29 CFR 1910.119 – Process Safety Management of Highly Hazardous Chemicals – SIS design cycle - Process Control vs Safety Control.

UNIT II PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS 9

Prevention Layers: Process Plant Design, Process Control System, Alarm Systems, Procedures, Shutdown/Interlock/Instrumented Systems (Safety Instrumented Systems – SIS), Physical Protection - Mitigation Layers: Containment Systems, Scrubbers and Flares, Fire and Gas (F&G) Systems, Evacuation Procedures - Safety specification requirements as per standards, causes for deviation from the standards.

UNIT III SAFETY INTEGRITY LEVEL (SIL) **9**

Evaluating Risk, Safety Integrity Levels, SIL Determination Method : As Low As Reasonably

Practical (ALARP), Risk matrix, Risk Graph, Layers Of Protection Analysis (LOPA) – Issues related to system size and complexity –Issues related to field device safety – Functional Testing.
UNIT IV SYSTEM EVALUATION **9**
Failure Modes, Safe/Dangerous Failures, Detected/Undetected Failures, Metrics: Failure Rate, MTBF, and Life, Degree of Modelling Accuracy, Modelling Methods: Reliability Block Diagrams, Fault Trees, Markov Models - Consequence analysis: Characterization of potential events, dispersion, impacts, occupancy considerations, consequence analysis tools - Quantitative layer of protection analysis: multiple initiating events, estimating initiating event frequencies and IPL failure probabilities.
UNIT V CASE STUDY **9**
SIS Design check list - Case Description: Furnace/Fired Heater Safety Shutdown System: Scope of Analysis, Define Target SILs, Develop Safety Requirement Specification (SRS), SIS Conceptual Design, Lifecycle Cost Analysis, Verify that the Conceptual Design Meets the SIL, Detailed Design, Installation, Commissioning and Pre-startup Tests, Operation and Maintenance procedures.
TOTAL: 45 PERIODS

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

CO1	Ability to analyse the role of safety instrumented system in the industry.
CO2	Ability to Identify and analyse the hazards.
CO3	Ability to determine the safety integrity level for an application. Ability to characterize the safety environment in industry.
CO4	Ability to analyse the failure modes, failure rates and MTBF using various reliability engineering tools.
C05	Ability to apply the design, installation and maintenance procedures for SIS applied to industrial processes. Ability to present the results in written and oral forms.

TEXT BOOKS:

1. Paul Gruhn and Harry L. Cheddie," Safety Instrumented systems: Design, Analysis and Justification", ISA, 2nd edition, 2018.
2. Eric W. Scharpf, Heidi J. Hartmann, Harlod W. Thomas, "Practical SIL target selection: Risk analysis per the IEC 61511 safety Lifecycle", exida2nd Edition 2016.

REFERENCES

1. William M. Goble and Harry Cheddie, "Safety Instrumented Systems Verification: Practical Probabilistic Calculations" ISA, 2005.
2. Edward Marszal, Eric W. Scharpf, "Safety Integrity Level Selection: Systematic Methods Including Layer of Protection Analysis", ISA, 2002.
3. Standard - ANSI/ISA-84.00.01-2004 Part 1 (IEC 61511-1 Mod) "Functional Safety: Safety Instrumented Systems for the Process Industry Sector - Part 1: Framework, Definitions, System, Hardware and Software Requirements", ISA, 2004.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	0	0	3	0	0	3	0	0	0	0	0	3	0	2	2
CO2	0	0	3	1	0	2	1	1	0	0	1	1	0	2	2
CO3	0	0	2	1	0	2	2	1	0	0	1	1	0	2	2
CO4	0	0	2	1	0	2	2	1	0	0	1	1	0	2	2
CO5	0	0	2	1	0	2	2	1	0	0	1	1	0	2	2

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

EC1007	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

Course 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	**9**
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:

CO1	Articulate and apply the concepts of special random processes in practical applications
CO2	Choose appropriate spectrum estimation techniques for a given random process
CO3	Apply optimum filters appropriately for a given communication application
CO4	Apply appropriate adaptive algorithm for processing non-stationary signals
CO5	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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	1	2	1	1	0	0	0	0	0	0	0	3	2	1
CO2	3	1	2	1	1	0	0	0	0	0	0	0	3	2	1
CO3	3	1	2	1	1	0	0	0	0	0	0	0	3	2	1
CO4	3	2	2	1	1	0	0	0	0	0	0	0	3	3	2
CO5	3	2	2	1	1	0	0	0	0	0	0	0	3	3	2

EC1702	RADAR AND NAVIGATIONAL AIDS	L	T	P	C
		3	0	0	3

COURSE 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

COURSE OUTCOMES

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

CO1	Explain principles of navigation, in addition to approach and landing aids as related to navigation
CO2	Derive and discuss the Range equation and the nature of detection.
CO3	Describe about the navigation systems using the satellite.
CO4	Describe about radio direction and ranges
CO5	Describe about satellite navigation system

TEXT BOOKS

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

REFERENCES

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	2	2	1	-	-	-	-	-	-	-	2	2	-
CO2	3	3	2	2	1	-	-	-	-	-	-	-	2	1	-
CO3	3	3	3	3	1	-	-	-	-	-	-	-	3	2	-
CO4	3	3	3	3	1	-	-	-	-	-	-	-	2	2	-
CO5	3	3	3	2	1	-	-	-	-	-	-	-	2	2	-

EC1731	**CMOS 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 trade-offs 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 Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear		**CO1**

Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.		
UNIT - II	**COMBINATIONAL MOS LOGIC CIRCUITS**	**9**
Circuit Families: Static CMOS, Ratioed Circuits, Cascade 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.		**CO2**
UNIT - III	**SEQUENTIAL CIRCUIT DESIGN**	**9**
Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Mono stability Sequential Circuits, Astability Sequential Circuits. Timing Issues: Timing Classification Of Digital System, Synchronous Design.		**CO3**
UNIT - IV	**DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUB SYSTEM**	**9**
Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed trade-offs, Case Study: Design as a trade-off. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.		**CO4**
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.		**CO5**
	Total Periods:	**45**

Text Books:

1. Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson , 2017.
2. Jan M. Rabaey, Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits: A Design perspective", Second Edition , Pearson , 2016.

Reference Books:

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 HillEducation,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.

Course Outcomes (CO)

CO1	Realize the concepts of digital building blocks using MOS transistor.
CO2	Design combinational MOS circuits and power strategies.
CO3	Design and construct Sequential Circuits and Timing systems.
CO4	Design arithmetic building blocks and memory subsystems.
CO5	Apply and implement FPGA design flow and testing.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	1	1	1	1	3	3	3	1	1	1	3	1	1	1
CO2	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO3	3	3	3	3	3	3	3	3	3	1	3	3	3	3	3
CO4	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	1	2	3	3	3	3

EI1741	THERMAL POWER PLANT INSTRUMENTATION	L	T	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, vibrationof 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. Details ofboiler 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 MONITORING AND CONTROL**	**9**

Types of steam turbines – impulse and reaction turbines – compounding – Turbine governing system, Speed measurement, rotor and casing movement- vibration - shell temperature monitoring and control - lubricant oil temperature - cooling system.

TOTAL :45 PERIODS

COURSE OUTCOMES

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

CO1	Understanding various power generation process.
CO2	Identify important parameter to be monitored and controlled in thermal power plant.
CO3	Knowledge about various building blocks and instruments involved in thermal power plant andits controlling process.
CO4	Understanding about boiler control
CO5	Understanding about turbine monitoring and control

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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	1	3	0	3	0	0	0	0	0	0	0	3	3	2
CO2	3	1	3	0	3	0	0	0	0	0	0	0	3	3	2
CO3	3	1	2	0	3	0	0	0	0	0	0	0	3	2	2
CO4	3	1	2	0	3	0	0	0	0	0	0	0	3	2	2

CO5	3	1	3	0	3	0	0	0	0	0	0	0	3	3	2	

EI1742	MECHATRONICS SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- The students will be exposed to design mechatronics system in Labview & Vim –Sim Environments

UNIT I	INTRODUCTION TO MECHATRONICS SYSTEM	9

Key elements – Mechatronics Design process –Design Parameters – Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.

UNIT II	SYSTEM MODELLING	9

Introduction-model categories-fields of application-model development-model verification-model validation-model simulation-design of mixed systems-electro mechanics design-model transformation-domain-independent description forms-simulator coupling.

UNIT III	REAL TIME INTERFACING	9

Introduction-selection of interfacing standards Elements of Data Acquisition & control Systems- Over view of I/O process, General purpose I/O card and its installation, Data conversion process, Application Software- Lab view Environment and its applications, Vim-Sim Environment & its applications -Man machine interface.

UNIT IV	CASE STUDIES ON MECHATRONIC SYSTEM	9

Introduction –Fuzzy based Washing machine – pH control system – Autofocus Camera, exposure control– Motion control using D.C.Motor& Solenoids – Engine management systems.– Controlling temperature of a hot/cold reservoir using PID- Control of pick and place robot – Part identification and tracking using RFID – Online surface measurement using image processing

UNIT V	MICRO MECHATRONIC SYSTEM	9

Introduction- System principle - Component design – System design – Scaling laws – Micro actuation – Micro robot – Micro pump – Applications of micro mechatronic components.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1	The students will be able to design systems in mechatronics approach using modern software packages.
CO2	The students will be able to do system modelling
CO3	The students will be able to do real time interfacing

CO4	Knowledge about mechatronic system
CO5	Knowledge about micro mechatronic system

TEXT BOOKS

1.	Devdas shetty, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition ,Cengage Learning 2011.
2.	Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL’s, John wiley and sons Ltd, 2003

REFERENCES

1.	Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002
2.	Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991 , First Indian print 2010.
3.	De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	2	2	2	3	-	-	-	-	-	-	1	2	-	-
CO2	3	2	2	2	3	-	-	-	-	-	-	1	2	1	-
CO3	3	2	2	2	3	-	-	-	-	-	-	1	3	2	-
CO4	3	2	2	2	3	-	-	-	-	-	-	1	2	2	-
CO5	3	2	2	2	3	-	-	-	-	-	-	1	2	2	-

EI1743	**ADVANCED PROCESS CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**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**	**9**
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**	**9**
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**	**9**
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**	**9**
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**	**9**
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: 45 PERIODS	

COURSE OUTCOMES

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

CO1	Ability to Apply knowledge of mathematics, science, and engineering to build and analyze

	models for time-varying systems and non-linear systems.
CO2	Ability to design and implement adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller
CO3	Ability to Identify, formulate, and solve optimal controller
CO4	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
CO5	Ability to use the FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

REFERENCES

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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	2	1	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	3	2	-

CO4	2	2	3	3	2	-	-	-	-	-	-	-	2	2	-
CO5	2	2	3	2	1	-	-	-	-	-	-	-	2	2	-

PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

GE1001	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

Objectives

- To introduce fundamental aspects of Intellectual Property Rights (IPR) and its components.
- To disseminate knowledge on patents, patent regime in India and abroad and registration aspects
- To disseminate knowledge on copyrights, trademarks and registration aspects
- To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
- To aware about enforcement in IPR and government steps in fostering IPR

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.		CO1

UNIT - II	REGISTRATION OF IPRs	9
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad		CO2

UNIT - III	AGREEMENTS AND LEGISLATIONS	9
International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.		CO3

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.		CO4

UNIT - V	ENFORCEMENT OF IPRs	9
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.		CO5

	Total Periods:	45

Text Books:

1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd,2014.
2. S. V. Satakar, "Intellectual Property Rights and Copy Rights, EssEss Publications, New Delhi, 2003.

3. Ahuja, V K, Law relating to Intellectual Property Rights. India, Lexis Nexis, 2017.

Reference Books:

1. Deborah E. Bouchoux, "Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets", Cengage Learning, Third Edition,2017.
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.

Course Outcomes (CO)

CO1	Ability to get an adequate knowledge on patent and copyright for their innovative research works
CO2	Ability to get idea about the registration process of IPR
CO3	Ability to study various agreements and Acts regarding IPR
CO4	Ability to inculcate the knowledge on innovations, developments and IP laws
CO5	Ability to aware the knowledge on enforcement and current issues

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3
CO2	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3
CO3	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3
CO4	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3
CO5	3	2	2	2	1	2	1	1	2	2	2	3	3	2	3

GE1003	PROFESSIONAL ETHICS IN ENGINEERING	L	T	P	C
		3	0	0	3

Objectives

- To create awareness on professional ethics and human values
- To create awareness on engineering ethics providing basic knowledge about engineering ethics, variety of moral issues, inquiry and virtues.
- To provide basic familiarity about engineers as responsible experimenters and codes of ethics
- To inculcate knowledge and exposure on safety, risk and rights of an employee

- To have an adequate knowledge about global issues in multi-national companies

UNIT – I	**HUMAN VALUES**	**9**
Morals, values and Ethics; Integrity; Work ethics; Service learning; Civic virtue; Respect for others; Living peacefully, Caring, Sharing, Honesty, Courage, Valuing time, Cooperation, Commitment, Empathy, Self-confidence, Character; Spirituality; Introduction to Yoga and meditation for professional excellence and stress management.		**CO1**
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.		**CO2**
UNIT – III	**ENGINEERING AS SOCIAL EXPERIMENTATION**	**9**
Engineering as Experimentation – Engineers as responsible Experimenters; Codes of Ethics; Balanced Outlook on Law.		**CO3**
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.		**CO4**
UNIT – V	**GLOBAL ISSUES**	**9**
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.		**CO5**
	Total Periods:	**45**

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.

Reference Books:

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, 2012.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 8th edition,2017.
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.

Course Outcomes (CO)

CO1	Define the dimensions or senses of engineering ethics and describe the various theories of moral development.
CO2	Describe the similarities and contrast of engineering experiments Vs scientific experiments and to define the code of ethics of various professional societies.
CO3	Understand significance of safety and risk assessment when developing engineering products.
CO4	Understand the social responsibilities and intellectual property rights of engineers.
CO5	Understand the process of how a multinational company works and to describe about the role of engineers in computer ethics, environment ethics, and weapons development

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3
CO2	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3
CO3	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3
CO4	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3
CO5	1	2	3	2	2	3	2	3	2	2	3	2	1	1	3

MG1001	PRINCIPLES OF MANAGEMENT	L	T	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.
- To learn the application of the principles in an organization.
- To acquire the skills of effective leadership and communication.
- To gain the knowledge of tools and techniques for an effective managerial skill.

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.		**CO1**
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.		**CO 2**
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.		**CO3**
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.		**CO4**
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.		**CO5**
	Total Periods:	**45**

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., 15th Edition, 2020.

Reference Books:

1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 10th Edition, 2015.
2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 11th Edition, Pearson Education, 2017.
4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 6th Edition 2017.

Course Outcomes (CO)

CO1	Ability to understand the various terms and definitions related to management and organization.
CO2	Ability to acquire the skill of planning and various strategies of management in an organization.
CO3	Ability to understand the various hierarchies of management and also get an insight into an HR values in an organization management.
CO4	Ability to acquire the skills of leadership and understand the importance of communication to run an organization effectively.
CO5	Ability to analyse the risk related to budget and methods to handle the risk with help of technology to manage an organization.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	2	2	2	2	2	3	3	3	3	3	1	1	1
CO2	1	2	2	2	3	3	3	3	3	3	3	3	1	1	1
CO3	2	2	2	2	3	2	2	3	3	3	3	3	1	1	1
CO4	1	1	2	2	3	3	3	3	3	3	3	3	1	1	1
C05	3	3	3	3	3	3	3	3	3	3	3	3	1	2	1

CE1025	DISASTER MANAGEMENT	L	T	P	C
	(Common to EEE,ECE,IT)	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.
- 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, Volcanoes, Forest fire, Manmade disaster; Causes, Impacts including social, economic, political, environmental, health, psychosocial; 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.		**CO1**

UNIT - II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9
Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness; Structural, non-structural measures; Community based DRR; Roles and responsibilities of community, Panchayat Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre & other stake holders; Institutional Processes and Framework at State and Central Level; State Disaster Management Authority(SDMA); Early Warning System, Advisories from appropriate agencies.		**CO2**

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 ; Climate Change Adaptation– IPCC Scenario and Scenarios in the context of India; Relevance of indigenous knowledge, appropriate technology and local resources.		**CO3**

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.		**CO4**

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.		**CO5**

Total Periods:	**45**

Text Books:

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, "Vulnerability India: A Geographical Study of Disasters" IIAS and Sage Publishers, New Delhi, 2010.

Reference Books:

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

Course Outcomes (CO):

CO1	Differentiate the types of disasters, causes and their impact on environment and society.
CO2	Assess vulnerability and various methods of risk reduction measures as well as mitigation.
CO3	Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.
CO4	Understand the disaster risk management process in India.
CO5	Acquire knowledge on disaster management applications and case studies.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	2	1	1	2	2	1	1	1	2	2	2	2	2
CO2	1	2	1	1	1	2	2	1	1	1	2	2	2	2	2
CO3	1	1	1	1	2	2	2	1	1	1	2	2	2	2	2
CO4	1	1	1	1	2	1	1	1	1	1	2	2	2	2	2
CO5	2	1	1	1	2	2	2	1	1	1	2	2	2	2	2

MG1002	OPERATIONAL RESEARCH	L	T	P	C
		3	0	0	3

Objectives

- To classify and formulate real-life problem for modelling, solving and applying for decision making.
- To study the formulation and various methods of solutions for linear programming, transportation, assignment , CPM and PERT problems
- To solve problems using dynamic programming method

UNIT - I	LINEAR MODELS	9

Introduction to operations research-Linear programming problems (LPP)-Graphical method-Simplex method-Big M Method-Dual simplex method-Primal Dual problems -Dual theory and Sensitivity analysis		**CO1**
UNIT – II	**TRANSPORTATION MODELS**	**9**
Transportation and assignment problems-Applications (Emphasis should be more on problems than theory)		**CO2**
UNIT – III	**NETWORK MODELS**	**9**
Shortest path problem: Dijkstra's algorithms, Floyd's algorithm, systematic method – CPM / PERT–Network diagram-Events and activities-Project Planning-Reducing critical events and activities-Critical path calculations-example-Sequencing problems.		**CO 3**
UNIT – IV	**DECISION MODELS AND INVENTORY MODELS**	**9**
Replacement problems-Capital equipment-Discounting costs-Group replacement. Inventory models-various costs- Deterministic inventory models-Economic lot size-Stochastic inventory models-Single period inventory models with shortage cost.		**CO 4**
UNIT – V	**QUEUING MODELS**	**9**
Characteristics of Queuing Models – Single and multi server models Poisson Queues - (M / M / 1) : (FIFO / ∞ /∞), (M / M / 1) : (FIFO / N / ∞), (M / M / C) : (FIFO / ∞ / ∞), (M / M / C) : (FIFO / N / ∞) models.		**CO5**
	Total Periods:	**45**

Text Books:

1. H. A. Taha, operational research-An introduction, Macmillan, 1976
2. F. S. Hiller and G. J. Liebermann, Introduction to operational research (7th edition)
3. B. E. Gillet, Introduction to operational research-A computer oriented algorithmic approach, McGraw Hill, 1989
4. H. M. Wagner, Principles of operational research with applications to managerial decisions, PH, Inc, 1975

Reference Books:

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.
6. J. C. Pant, 'Introduction to Optimisation: Operations Research', Jain Brothers, Delhi, 2008.
7. Pannerselvam, 'Operations Research', Prentice Hall of India 2010.

Course Outcomes (CO)	
CO1	To analyze the problems in engineering, management or business environment, focusing on important details
CO2	To formulate real problems in terms of input-output parameters relationships and identify the solution procedure
CO3	To understand the concept of network and project planning
CO4	To understand the inventory management in manufacturing context
CO5	To understand the application of queuing theory in real world

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	2	1	1	1	0	0	0	0	1	2	1	1	1
CO2	3	3	2	1	1	1	0	0	0	0	1	2	3	3	3
CO3	3	3	2	0	1	1	0	0	0	0	1	2	3	3	3
CO4	3	3	2	0	1	1	0	0	0	0	1	2	3	3	3
C05	3	3	2	1	1	1	0	0	0	0	1	2	3	3	3

MG1002	**PRINCIPLES OF OPERATION 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**	**9**
The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.		**CO1**

UNIT – II	**TRANSPORTATION MODELS AND NETWORK MODELS**	**9**
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.		**CO2**

UNIT – III	**INVENTORY MODELS**	**9**
Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.		**CO3**

UNIT – IV	QUEUEING MODELS	9
Queueing models – Queueing systems and structures – Notation parameter – Single server and multi-server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.		CO4
UNIT – V	**DECISION MODELS**	**9**
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 variability search technique – Dynamic Programming – Simple Problem.		CO5
	Total Periods:	**45**

Text Books:

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

Reference Books:

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. ShennFoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern, 1994.
5. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

Course Outcomes (CO)

CO1	Apply formulation and solution of Linear programming problem to practical applications like resource allocations and interpret the result with concept of duality and Sensitivity analysis.
CO2	Get the solution for transportation problems and project management problems
CO3	Handle and study the inventory models, which is inevitable in engineering and business situations.
CO4	Formulate Queuing models, upon study the solution of the same. Also handle the real life applications through simulation.
CO5	Analysis the decision making process through game theory.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	2	1	1	1	-	-	-	-	1	2	1	1	1
CO2	3	3	2	1	1	1	-	-	-	-	1	2	3	3	3

CO3	3	3	2	0	1	1	-	-	-	-	1	2	3	3	3
CO4	3	3	2	0	1	1	-	-	-	-	1	2	3	3	3
C05	3	3	2	1	1	1	-	-	-	-	1	2	3	3	3

GE1002	HUMAN RIGHTS	L	T	P	C
		3	0	0	3

Objectives

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

UNIT - I	INTRODUCTION	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.		CO1

UNIT - II	EVOLUTION OF HUMAN RIGHTS MOVEMENT	9
Evolution of the concept of Human rights- Magana Carta, Geneva Convection of 1864, Universal Declaration of Human rights 1948;Theories of Human rights.		CO2

UNIT - III	INTERNATIONAL PRESPECTIVES	9
Theories and perspective of UN Laws; UN Agencies to monitor and compliance.		CO3

UNIT - IV	HUMAN RIGHTS IN INDIA	9
Human Rights in India; Constitutional Provisions/ Guarantees.		CO4

UNIT – V	HUMAN RIGHTS SUPPORT ORGANISATION	9
Human Rights of Disadvantaged People - Women, Children, Displaced persons and Disable 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.		CO5

Total Periods:	45

Reference Books:

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.

Course Outcomes (CO)

CO1	Able to understand the definition and types of human rights

CO2	Able to understand the evolution and theories of human rights
CO3	Able to understand the theories and perspectives of human rights
CO4	To know about human rights in India
CO5	To know about human rights of people of various classes and implementation of human rights

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	2	2	1	1	1	1	1	1

PROFESSIONAL ELECTIVE – VI (VIII SEMESTER)

GE1004	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	9
Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering- Classifications of nanostructured materials- quantum dots, nano wires-ultra-thin films multi layered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).		**CO1**

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.		**CO2**

UNIT - III	NANOMATERIALS	9
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,		**CO3**

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-Nano indentation.		**CO4**

UNIT - V	**APPLICATIONS**	**9**
Nano InfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nano biotechlogy: 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.		**CO5**
	Total Periods:	**45**

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.

Reference Books:

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.

Course Outcomes (CO)

CO1	Ability to understand the concept of Nano scale Science and Technology and various types of nano materials.
CO2	Ability to acquire knowledge in general methods of preparation of nano materials.
CO3	Ability to understand the Nano forms of Carbon and methods of synthesis
CO4	Ability to acquire knowledge in characteristic nanomaterial on various technique.
CO5	Ability to gain knowledge on various application of nano materials.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**L**	**1**	**2**	**3**
CO1	3	2	2	3	1	2	1	1	2	1	1	3	2	2	3
CO2	3	2	3	3	1	2	1	1	2	1	1	3	3	2	3
CO3	3	3	3	3	1	2	1	1	2	1	1	3	3	2	3

CO4	3	3	3	3	1	2	1	1	2	1	2	3	3	2	3
CO5	3	2	3	3	1	2	1	1	2	1	2	3	3	2	3

EI1861	NON-LINEAR CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the nature of non-linear systems and to analyze the stability of such systems
- To develop suitable models of non-linear systems and to develop suitable controllers for such systems
- To understand the chaotic and bifurcation behavior of non-linear systems
- To linearize the non-linear systems

Unit-I **NON-LINEAR SYSTEMS** **9**

Types of Non-Linearity – Typical Examples – Properties of nonlinear systems – Nonlinear differential equations – Numerical solutions to nonlinear differential equations – Equilibrium points – free and forced responses – Input and output multiplicities.

Unit-II **STABILITY OF NON-LINEAR SYSTEMS** **9**

BIBO and Asymptotic stability – Phase plane analysis (analytical and graphical methods) – Lyapunov Stability Criteria – Krasovskil's method – Variable Gradient Method – Stability Analysis by Describing function method.

Unit-III **MODELLING AND CONTROL OF NON-LINEAR SYSTEMS** **9**

Models for Nonlinear systems - Hammerstein and Wiener models - Input signal design for Identification – On-line parameter estimation for nonlinear systems – Nonlinear PID controller – Gain scheduling control – case studies

Unit-IV **CHAOS AND BIFURCATION BEHAVIOR** **9**

Introduction to Chaos - The Lorenz Equations – Test for chaos - Bifurcation Behavior of ordinary differential equations - Types of Bifurcations - Limit Cycle Behavior and Hopf Bifurcation.

Unit-V **LINEARIZATION** **9**

Methods of linearization – Taylor's series expansion – Jacobean method - state model for systems – Role of Eigen values and Eigenvectors – State transition matrix and its properties – Controllability and observability – Stabilizability and Detectability

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1	Ability to apply mathematical knowledge and basics of science and engineering to develop model for non-linear system.
CO2	Ability to analyze non-linear system based on the first principle model.
CO3	Ability to come out the solution for complex non-linear system.
CO4	Ability to develop various control schemes for non-linear systems.
C05	Ability to linearize non-linear system for developing linear control.
TEXT BOOKS	
1.	Hangos, K.M., Bokor, J., and Szederkrnyi, G., "Analysis and control of Non-linear Process systems".
2.	Gopal, M., "Digital Control and State Variable Methods: Conventional and Intelligent Control Systems", Fourth Edition, Tata McGraw-Hill, 2012.
REFERENCES	
1.	Shankar Sastry, "Nonlinear Systems: Analysis, Stability, and Control", Springer New York, 2013.
2.	Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2008.
3.	Bequette, B.W., "Process Control: Modeling, Design and Simulation", Prentice Hall International series in Physical and Chemical Engineering Sciences, 2003.
4.	Steven E. LeBlanc, and Donald R. Coughanowr, "Process Systems Analysis and Control", 3rd Edition, Chemical Engineering series, McGraw-Hill Higher Education, 2009.
5.	**5.** Thompson, J. M. T., and Stewart, H. B.," Nonlinear Dynamics and Chaos", John Wiley & Sons, 2002.
6.	William S. Levine, "The Control Systems Handbook", Second Edition: Control System Advanced Methods, 2nd Edition, CRC Press, 2010.
7.	NPTEL Lecture on "Non-linear system Analysis" by Prof. Laxmidhar Behera, IIT Kanpur.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1	2	3	1	1	0	0	0	0	1	0	1	2	2	0
CO2	1	2	2	1	1	0	0	0	0	1	0	1	2	2	0
CO3	1	2	2	1	1	0	0	0	0	1	0	1	2	2	0

CO4	1	2	1	1	1	0	0	0	0	1	0	1	2	2	0
CO5	1	2	3	1	1	0	0	0	0	1	0	1	2	2	0

EI1862	UNIT OPERATION AND CONTROL	L	T	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 chemicalreactors.

UNIT I	MECHANICAL OPERATIONS- I: OPERATIONS ON SOLIDS	9
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: OPERATIONS ON FLUIDS**	**9**
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 (L: 45): 45 PERIODS	

COURSE OUTCOMES

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

CO1	Apply the knowledge on solids & fluids to handle the raw materials.
CO2	Select and apply relevant handling techniques to convert the solids and fluids for specific applications.
CO3	Come out with solutions for simple/complex problems in heat transfer and design the heatexchange equipment for different applications such as distillation, boilers.
CO4	Able to carry out multidisciplinary projects using heat transfer, mass transfer concepts.
CO5	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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1863	CYBER SECURITY FOR INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

•	To understand the Industrial security environment and cyberattacks
•	To analyze and assess risks in the industrial environment
•	To access, design and implement cybersecurity
•	To test and troubleshoot the industrial network security system

UNIT I	INTRODUCTION	9
Industrial security environment-Industrial automation and control system (IACS) culture Vs IT Paradigms-Cyberattacks: Threat sources and steps to successful cyberattacks.		
UNIT II	**RISK ANALYSIS**	**9**
Risk identification, classification and assessment, Addressing risk:Cybersecurity Management System(CSMS), organizational security, physical and environmental security, network segmentation, access control, risk management and implementation.		

UNIT III	**ACCESSING THE CYBERSECURITY OF IACS**	**9**
Identifying the scope of the IACS- generation of cybersecurity information-identification of vulnerabilities- risk assessment-evaluation of realistic threat scenarios- Gap assessment-capturing Ethernet traffic- documentation of assessment results		
UNIT IV	**CYBERSECURITY DESIGN AND IMPLEMENTATION**	**9**
Cybersecurity lifecycle- conceptual design process- detailed design process- firewall designremote access design- intrusion detection design		
UNIT V	**TESTING AND MAINTENANCE**	**9**
Developing test plans- cybersecurity factory acceptance testing- site acceptance testing- network and application diagnostics and troubleshooting- cybersecurity audit procedure- IACS incident response		
		TOTAL: 45

COURSE OUTCOMES

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

CO1	Ability to apply basis of science and engineering to understand Industrial security environment and cyberattacks.
CO2	Ability to analyze and assess risks in the industrial environment
CO3	Ability to access the cybersecurity of IACS
CO4	Ability to design and implement cyber security
CO5	Ability to test and troubleshoot the industrial network security system.

TEXT BOOKS

1.	Ronald L and Krutz, Industrial Automation and Control System Security Principles,ISA, 2013.
2.	David J.Teumim, Network Security, Second edition,ISA,2010

REFERENCES

1.	Edward J.M. Colbert and Alexander Kott, Cyber-security of SCADA and other industrial control systems, Springer, 2016.
2.	Perry S. Marshalland John S. Rinaldi, Industrial Ethernet, Second edition, ISA, 2004

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1														2

CO2	1	1													1
CO3	1	1													2
CO4	1		2		2										1
CO5	1		2									2			2

EI1864	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

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 - **Introduction about Robotic languages.**

UNIT II POWER SOURCES, SENSORS AND ACTUATORS 9

Hydraulic, pneumatic and electric drives: Design and control issues – 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 and arm singularity - Static analysis - Force and moment Balance Solution kinematics problem – robot programming languages.

UNIT V DYNAMICS AND CONTROL AND APPLICATIONS 9

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control 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 have the:

CO1	Ability to understand the evolution of robot technology and its applications.
CO2	Ability to known the mathematical representation of different types of robots
CO3	Get exposed to the case studies and design of robot machine interface.
CO4	Familiarize various control schemes of Robotics control.
CO5	Ability to known various robots applications.

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. John.J.Craig, Introduction to Robotics Mechanics and Control, Third edition, PearsonEducation,2009.
6. Issac Asimov, I Robot, Ballantine Books, New York, 1986.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO2	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO3	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO4	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-
CO5	2	2	1	1	1	-	-	-	-	-	-	1	2	2	-

EI1865	INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To introduce the students the method of oil recovery and the steps involved in oil gas production process
2. To make the students understand the process behavior of some of the important unit operations in petrochemical industry through mathematical model
3. To familiarize the students to apply knowledge to select the appropriate control strategy for the selective process.
4. To provide information about the most important derivatives obtained from petroleum products
5. 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**
Petroleum-chemical composition, petroleum conversion process- 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

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

CO1	Gain knowledge on oil gas production process and important unit operations in a refinery
CO2	Having gained the process knowledge, ability to develop and analyze mathematical model of selective processes
CO3	. Able to develop, analyze and select appropriate control strategy for selective unit operations in a refinery
CO4	Gain knowledge on the most important chemical derivatives obtained from petroleum products
CO5	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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	2	1	1	1	-	-	-	-	-	-	1	2	1	-
CO2	3	2	1	1	1	-	-	-	-	-	-	1	2	1	-
CO3	3	2	1	1	1	-	-	-	-	-	-	1	2	1	-
CO4	3	2	1	1	1	-	-	-	-	-	-	1	2	1	-
CO5	2	2	1	-	2	-	-	-	-	-	-	_	2	2	-

OPEN ELECTIVE -I (VI SEMESTER)

OCS103	INTRODUCTION TO CLOUD COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the concept of cloud computing.
- To learn about the concept of cloud and utility computing.
- To have knowledge on the various issues in cloud computing.
- To appreciate the emergence of cloud as the next generation computing paradigm.

UNIT I	INTRODUCTION	9
Introduction to Cloud Computing– Definition of Cloud– Evolution of Cloud Computing- Roots of Cloud Computing– Desired Features of Cloud Computing-– Benefits and Disadvantages of Cloud Computing- On-demand provisioning.		CO1

UNIT II	VIRTUALIZATION	9
Introduction to Virtualization Technology– Service Oriented Architecture- Web Services– Load Balancing and Virtualization- Hypervisor– Seven Layers of Virtualization - Types of Virtualization – Server, Desktop, and Application Virtualization.		CO2

UNIT III	CLOUD ARCHITECTURE, SERVICES AND STORAGE	9
NIST Cloud Computing Reference Architecture– Public, Private and Hybrid Clouds – laaS – PaaS – SaaS– Architectural Design Challenges– Cloud Storage - Storage-as-a-Service -S3-AdvantageofCloudStorage,MongoDB.		CO3

UNIT IV	RESOURCE MANAGEMENT AND SECURITY IN CLOUD	9
Inter Cloud Resource Management-– Resource Provisioning Methods– Security Overview– Cloud Security Challenges–Data Security–Application Security–Virtual Machine Security.		CO 4

UNIT V	CLOUD ADVANCEMENT TECHNOLOGIES	9
Google App Engine(GAE) – GAE Architecture – Functional Modules of GAE- Dockers- AWS-Kubernetes-Pods-Container-container-Hadoop – Map Reduce – Oracle Virtual box-Cloud Software Environments- – Eucalyptus – Open Nebula.		CO5

TOTAL : 45 PERIODS

TEXT BOOKS

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
3. Rittinghouse, John W., and James F. Ransome, "Cloud Computing: Implementation, Management, And Security", CRC Press, 2017

REFERENCE BOOKS

1. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
2. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.
3. https://kubernetes.io/docs/home/
4. https://docs.mongodb.com/
5. https://aws.amazon.com/documentdb/

COURSE OUTCOMES(CO)

CO1	Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
CO2	Learn the key and enabling technologies that help in the development of cloud.
CO3	Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.
CO4	Explain the core issues of cloud computing such as resource management and security.
CO5	Be able to install and use current cloud technologies and Choose the appropriate technologies and approaches for implementation and use of cloud.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	L	1	2	3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2

CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
C05	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2

OCS104	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

Objectives

- To learn the fundamentals of data models
- To learn conceptual modeling using ER diagrams.
- To study SQL queries and database programming
- To learn proper designing of relational database.
- To understand database security concepts
- To understand Information retrieval techniques

UNIT - I	DBMS AND CONCEPTUALDATAMODELING	9
Purpose of Database System – Data independence - Data Models – Database System Architecture – Conceptual Data modeling: ER models - Enhanced-ER Model. Introduction to relational databases – Relational Model – Keys – ER-to-Relational Mapping. Modeling of a library management system.		**CO1**

UNIT - II	DATABASE QUERYING	9
Relational Algebra – SQL: fundamentals – DDL – Specifying integrity constraints - DML – Basic retrieval queries in SQL - Complex SQL retrieval queries – nested queries – correlated queries –joins aggregate functions. Creating a table, populating data, adding integrity constraints, querying tables with simple and complex queries.		**CO2**

UNIT – III	DATABASE PROGRAMMING	9
Database programming with function calls, stored procedures - views – triggers. Embedded SQL. ODBC connectivity with front end tools. Implementation using ODBC/JDBC and SQL/PSM, implementing functions, views, and triggers in MySQL / Oracle		**CO3**

UNIT – IV	DATABASE DESIGN	9
Functional Dependencies – Design guidelines – Normal Forms: first, second, third – Boyce/Codd Normal Form – Normalization algorithms. Design of a banking database system / university database system.		**CO4**

UNIT – V	ADVANCED TOPICS	9
Database security issues – Discretionary access control – role based access – Encryption and public key infrastructures – challenges. Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.		**CO5**

	Total Periods:	**45**

Text Books:

1. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Sixth Edition , Pearson,2011.
2. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill,2011

Reference Books:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education,2006.
2. Raghu Ramakrishnan, ―Database Management Systems, Fourth Edition, McGraw-Hill College Publications,2015.

Course Outcomes (CO)

CO1	Ability to understand relational data model, evolve conceptual model of a given problem.
CO2	Understand query the relational database and write programs with database connectivity
CO3	Ability to understand the DBMS programming
CO4	Ability to understand the DBMS Design
CO5	Ability to understand the database security and information retrieval concepts

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	F	G	h	i	J	k	L	1	2	3
CO1	3	3	3	1	1	1	1	1	3	3	1	1	3	2	2
CO2	3	3	3	1	1	1	1	1	3	3	1	1	3	3	2
CO3	3	3	3	1	1	1	1	2	3	3	1	1	3	3	2
CO4	3	3	3	1	1	2	1	2	3	3	1	1	3	3	2
CO5	3	3	3	1	1	1	1	2	3	3	1	1	3	2	2

OME106	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

Objectives

- To study the various material testing methods and standards.
- To study the various mechanical testing and material characterization
- To study the various destructive and non-destructive testing methods of materials and its industrial applications.

UNIT - I	**INTRODUCTION TO MATERIALS TESTING**	**9**
Overview of materials: Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.		**CO1**
UNIT - II	**MECHANICAL TESTING**	**9**
Introduction to mechanical testing: Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations,Applications.		**CO2**
UNIT - III	**NON DESTRUCTIVE TESTING**	**9**
Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.		**CO3**
UNIT - IV	**MATERIAL CHARACTERIZATION TESTING**	**9**
Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.		**CO4**
UNIT - V	**OTHER TESTING**	**9**
Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.		**CO5**
	Total Periods:	**45**

Text Books:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu, "Practical Non-Destructive Testing", 3rd and later Edition, Narosa Publishing House, 2014.
2. Cullity, B. D., "Elements of X-ray diffraction", 3rd Edition, Addison-Wesley Company Inc., New York, 2005.
3. P. Field Foster, "The Mechanical Testing of Metals and Alloys", 7th Edition, Cousens Press, 2007.
4. Suryanarayana A. V. K., "Testing of metallic materials", 2nd Edition, BS publications, 2018

Reference Books:

1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986. Publishing, 1998.

Course Outcomes (CO): At the end of the course students will have the,	
CO1	Ability to Identify various materials, different types of material testing, material testing standards and organizations, characterization and techniques
CO2	Ability to Identify various mechanical testing and its procedure with application for industrial use.
CO3	Ability to understand the various non-destructive testing techniques with application for industrial use.
CO4	Ability to analyze the surface and elemental behavior of various materials using different material characterization techniques.
CO5	Ability to understand the thermal and chemical behavior of various materials by special testing techniques.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	L	1	2	3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
C05	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2

OBT104	**BIOSENSORS**	**L**	**T**	**P**	**C**
		3	0	0	3

OBJECTIVE

- Understand protein based biosensors and their enzyme reactivity, stability and their application

UNIT I	**PROTEIN BASED BIOSENSORS**	**9**
Nano structure for enzyme stabilization - Single enzyme nano particles - Nanotubes microporus silica - Protein based nanocrystalline Diamond thin film for processing		**CO1**
UNIT II	**DNA BASED BIOSENSOR**	**9**
Heavy metal complexing with DNA and its determination water and food samples - DNA zymo biosensors		**CO2**
UNIT III	**ELECTRO CHEMICAL APPLICATION**	**9**

Detection in biosensors - Flurorescence - Absorption - Electrochemical. Integration of various techniques - Fibre optic biosensors		**CO3**
UNIT IV	**FABRICATION OF BIOSENSORS**	**9**
Techniques used for microfabrication - Microfabrication of electrodes - On chip analysis		**CO4**
UNIT V	**BIOSENSORS IN RESEARCH**	**9**
Future direction in biosensor research - Designed protein pores-as components of biosensors - Molecular design -Bionanotechnology for cellular biosensing - Biosensors for drug discovery - Nanoscale biosensors		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCE BOOKS

1. Biosensors: A Practical Approach, J. Cooper & C. Tass, Oxford University Press, 2004
2. Nanomaterials for Biosensors, Cs. Kumar, Willey - VCH, 2007
3. Smart Biosensor Technology, G.K. Knoff, A.S. Bassi, CRC Press, 2006.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	The students will able to understand protein based biosensors and their enzyme reactivity, stability and their application in protein based nano crystalline thin film processing
CO2	The students will able to describe DNA based biosensors to study the presence of heavy metals in the food products
CO3	The students will able to understand fluorescence, UV-Vis and electrochemical applications of biosensors
CO4	The students will able to study about the fabrication of biosensors and its application as nanochipanalyzer
CO5	To understand the Future direction in biosensor research

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**	**Program Specific Outcomes**

	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	1	3	2	1	2	2	4	2	1	1	1	2	1	1
CO2	3	2	1	2	2	1	2	1	3	4	1	2	1	1	2
CO3	1	2	4	3	1	2	4	3	1	2	4	5	1	2	2
CO4	1	2	2	4	2	1	1	1	2	1	3	2	1	2	2
CO5	2	1	3	1	2	4	3	2	1	2	3	1	1	2	2

OEE107	SOLAR AND WIND ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand types and applications of various form of energy sources and its environmental impacts
- To attain a broad comprehension of solar photovoltaic systems used for various applications.
- To understand and estimate performance of wind turbine

UNIT - I	INTRODUCTION OF SOLAR ENERGY	9
Solar radiation at the earth's surface - solar radiation measurements - estimation of average solar radiation - solar thermal flat plate collectors - concentrating collectors - solar thermal applications - heating, cooling, desalination, drying, cooking, etc - solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells		CO1

UNIT - II	SOLAR PHOTOVOLTAIC TECHNOLOGY	9
Photovoltaic basics - structure and working of solar cells - types, electrical properties and behaviour of solar cells - cell properties and design, stand alone PV systems - schematics, components, batteries, charge conditioners, grid connected PV systems - schematics, components , charge conditioners, interface components, hybrid systems - solar, biomass, wind, diesel hybrid systems, design of PV systems - radiation and load data, simple case studies.		CO2

UNIT - III	PHOTOVOLTAIC APPLICATIONS	9
Battery charger, domestic lighting, street lighting, water pumping etc - Solar PV power plant - Net metering concept. National / International PV Power Programmes - Photovoltaic Power Systems - System Integration - Energy Storage - Power Electronics - Stand-Alone Systems - Grid-Connected Systems - Concentrating Photovoltaics (CPV) - Electrical Performance. Applications of IoT and Machine learning for SPV applications.		CO3

UNIT - IV	WIND ENERGY	9
Nature of the wind - power in the wind - factors influencing wind - wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications - offshore wind		CO4

energy - Hybrid systems - safety and environmental aspects - wind energy potential and installation in India - Repowering concept.	

UNIT - V	**AERODYNAMICS AND PERFORMANCE OF WIND TURBINE**	**9**
Horizontal Axis Wind Turbine (HAWT) & Vertical Axis Wind Turbine (VAWT), Power Developed, Maximum power coefficient (Betz Limit), Thrust, Efficiency, Rotor selectionRotor design considerations, Diameter of the Rotor. Aerodynamic design principles, Blade Profile, Blade Element Theory, Choice of the number of blades, Choice of the Pitch angle, Tip speed ratio, Power speed characteristics, Torque speed characteristics, Solidity. Applications of IoT and Machine learning for wind turbines performance assessment.		CO5

TOTAL PERIODS:	**45**

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

CO1	Understand the basics of solar energy and its measurements applications
CO2	Understand the fundamentals of solar photovoltaic technology and design different SPV systems
CO3	Understand the application of solar photovoltaic technologies
CO4	Understand the wind resource assessment and conversion systems
CO5	Analyse wind turbine performance with regard to aerodynamics

TEXT BOOKS:

1. Sukhatme, S.P., Solar Energy, Tata McGraw Hill, 1984
2. Twidell& Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011 G.D. , "Non-Conventional Energy Sources",

REFERENCE BOOKS:

1. Rai G.D. , "Non-Conventional Energy Sources", Khanna Publishers, 2011
2. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2011
3. Ramesh R & Kumar K.U , "Renewable Energy Technologies",Narosa Publishing House, 2010
4. Mittal K M , "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2010
5. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi, 2010.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**C**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2

CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
C05	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2

OME104	**INDUSTRIAL SAFETY ENGINEERING**	**L**	**T**	**P**	**C**
		3	0	0	3

❖ OBJECTIVES:

❖ · To impart knowledge on safety engineering fundamentals and safety management practices.

UNIT I	**INTRODUCTION**	**9**
Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.		**CO1**
UNIT II	**CHEMICAL HAZARDS**	**9**
Chemical exposure – Toxic materials – Ionizing Radiation and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.		**CO2**
UNIT III	**ENVIRONMENTAL CONTROL**	**9**
Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.		**CO3**
UNIT IV	**HAZARD ANALYSIS**	**9**
System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment		**CO4**
UNIT V	**SAFETY REGULATIONS**	**9**
Explosions – Disaster management – catastrophe control, hazard control ,Safety education and training - Factories Act, Safety regulations Product safety – case studies.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.
REFERENCE BOOKS
1. Safety Manual, “EDEL Engineering Consultancy”, 2000. 2. David L.Goetsch, “Occupational Safety and Health for Technologists”, 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	understand the basic safety concepts in Industrial boilers, pressure vessels
CO2	understand the hazardous effects caused and prevention methods of chemicals used in industry
CO3	understand the environmental measures and controls towards safety
CO4	understand the analysis of safety preventions and hazards in industry
CO5	understand the safety regulations and safety management.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2
C05	3	3	3	3	2	-	-	-	-	2	2	2	1	2	2

OCE101	AIR POLLUTION AND CONTROL	L	T	P	C
	(COMMON TO BIOTECH, EEE, EIE, MECH)	3	0	0	3
Objectives					

- To impart knowledge on the principle and design of particulate/ gaseous air pollutant and its emerging trends.
- To acquaint the students with the basics of selection of control equipment.
- To learn about indoor air quality control.

UNIT - I	**AIR QULALITY MONITORING**	**9**
Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards –Composition of Particulate and Gaseous Pollutants.		**CO1**
UNIT - II	**EFFECT OF ATMOSPHERIC DISPERSION**	**9**
Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.		**CO2**
UNIT - III	**PARTICULATE CONTAMINANTS**	**9**
Gas Particle Interaction – Working principle, Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations- Factors affecting Selection of Control Equipment.		**CO3**
UNIT - IV	**GASEOUS CONTAMINANTS**	**9**
Working principle, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring – Operational Considerations- Factors affecting Selection of Control Equipment –CO2 capturing.		**CO4**
UNIT - V	**INDOOR AIR QUALITY MONITORING**	**9**
Sources, types and control of indoor air pollutants, sick building syndrome types –Sources and Effects of Noise Pollution– Standards–Control and Preventive measures.		**CO5**
	Total Periods:	**45**

Text Books:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science + science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press,Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

Reference Books:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.

3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.

Course Outcomes (CO) : The students completing the course will have

CO1	Understand the chemistry of atmosphere, characterize the air pollutants , know the effects of air pollution, identify the criteria air pollutants and know about NAAQS
CO2	Apply the knowledge of mathematics and science fundamentals to understand the concept of meteorology, air pollution dispersion and Gaussian plume dispersion model
CO3	Select suitable method and design the particulate pollutant control equipment
CO4	Select appropriate method for control of gaseous pollutant by due consideration of sources of emission
CO5	Understand the source of indoor air pollution, effects and control methods as well as to identify the source of noise, and select suitable method for control of noise pollution

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	I	j	k	l	1	2	3
CO1	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO2	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO3	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO4	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO5	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2

OPEN ELECTIVE -II (VII SEMESTER)

OCS105	DATA ANALYTICS WITH R PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- Students will learn R. Programming language, data analytics, data visualization and statistical model for data analytics
- By completion of this course, students will be able to become data analyst

UNIT I	INTRODUCTION TO DATA ANALYSIS	9
Overview of Data Analytics, Need of Data Analytics, Nature of Data**,** Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics		**CO1**

UNIT II	**R PROGRAMMING BASICS**	**9**
Overview of R programming, Environment setup with R Studio, R Commands, Variables and Data Types, Control Structures, Array, Matrix, Vectors, Factors, Functions, R packages		**CO2**
UNIT III	**DATA VISUALIZATION USING R**	**9**
Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. **Working with R Charts and Graphs:** Histograms, Boxplots, Bar Charts, Line Graphs, Scatterplots, Pie Charts		**CO3**
UNIT IV	**STATISTICS WITH R**	**9**
Random Forest, Decision Tree, Normal and Binomial distributions, Time Series Analysis, Linear and Multiple Regression, Logistic Regression		**CO4**
UNIT V	**PRESCRIPTIVE ANALYTICS**	**9**
Creating data for analytics through designed experiments, Creating data for analytics through active learning, Creating data for analytics through reinforcement learning		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. An Introduction to R, Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team.
   URL: https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf

REFERENCE BOOKS

1. Jared P Lander, R for everyone: advanced analytics and graphics, Pearson Education, 2013 Dunlop, Dorothy D., and Ajit C. Tamhane. Statistics and data analysis: from elementary to intermediate. Prentice Hall, 2000.
2. G Casella and R.L. Berger, Statistical Inference, Thomson Learning 2002.
3. P. Dalgaard. Introductory Statistics with R, 2nd Edition. (Springer 2008)
4. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
5. Hastie, Trevor, et al.The elements of statistical learning.Vol. 2. No. 1. New York: springer, 2009.
6. Montgomery, Douglas C., and George C. Runger. Applied Statistics and Probability for Engineers. John Wiley &Sons, 2010
7. Joseph F Hair, William C Black etal , "Multivariate Data Analysis" , Pearson Education, 7th edition, 2013.
8. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley & Sons, Inc., 2012.
9. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Understand the basics of data analytics
CO2	Understand and apply the R-Programming concepts
CO3	Apply R-Programming for data visualization
CO4	Implement various classification techniques using R
CO5	Apply R programming to perform perspective analytics on data

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO2	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO3	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO4	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2
CO5	3	3	3	3	2	-	-	-	-	2	2	2	3	1	2

OME102	DESIGN OF EXPERIMENTS	L	T	P	C
		3	0	0	3

Objectives

- To demonstrate knowledge and understanding of Classical Design of Experiments (DOE).
- To demonstrate knowledge and understanding of Taguchi's approach.
- To develop skills to design and conduct experiments using DOE and Taguchi's approach.
- To develop competency for analysing the data to determine the optimal process parameters that optimize the process.

UNIT - I	**FUNDAMENTALS OF EXPERIMENTAL DESIGNS**	**9**
Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, testing using Analysis of variance.		**CO1**
UNIT - II	**SINGLE FACTOR EXPERIMENTS**	**9**
Completely Randomized Design- effect of coding the observations- model adequacy checking - estimation of model parameters, residuals analysis- treatment comparison methods- Duncan's multiple range test, Newman- Keuel's test, Fisher's LSD test, Tukey's test- testing using contrasts- Randomized Block Design – Latin Square Design- Graeco Latin Square Design – Applications.		**CO2**
UNIT - III	**FACTORIAL DESIGNS**	**9**
Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design - Practical applications.		**CO3**
UNIT - IV	**SPECIAL EXPERIMENTAL DESIGNS**	**9**
Blocking and Confounding in 2^K Designs- blocking in replicated design- 2^K Factorial Design		**CO4**

in two blocks- Complete and partial confounding- Confounding 2^K Design in four blocks- Two level Fractional Factorial Designs- one-half fraction of 2^K Design, design resolution, Construction of one-half fraction with highest design resolution, one-quarter fraction of 2^K Design- introduction to response surface methods, central composite design.		
UNIT - V	**TAGUCHI METHODS**	**9**
Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal experiments- Response Graph Method, ANOVA- attribute data analysis- Robust design- noise factors, Signal to noise ratios, Inner/outer OA design- case studies.		**CO5**
	Total Periods:	**45**

Text Books:

1. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 2012.

Reference Books:

1. Box, G. E., Hunter,W.G., Hunter, J.S., Hunter,W.G., "Statistics for Experimenters: Design, Innovation, and Discovery", 2nd Edition, Wiley, 2005.
2. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2011.
3. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2005.

Course Outcomes (CO)
Upon completion of course, the students will be able to

CO1	understand the basic principle of DOEs and ANOVA.
CO2	understand the various single factor experiments
CO3	learn full and fraction factorial experiment design.
CO4	Ability to design various resolution using 2^k.
CO5	understand the Taguchi Orthogonal Arrays.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	l	1	2	3
CO1	3	1	2	2	2	1	2	1	1	1	1	3	2	1	1
CO2	3	2	2	1	2	1	2	1	1	1	2	3	2	1	1
CO3	3	2	1	2	2	1	2	1	1	1	2	3	2	1	1
CO4	3	1	2	2	2	1	2	1	1	1	1	3	2	1	1

CO5	3	2	2	2	2	1	2	1	1	1	1	3	2	1	1

OME105	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
- Basic idea about the planning in product design.
- Basic idea about the industrial design tools.
- Basic idea about patents.

UNIT I	INTRODUCTION	9
Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.		**CO1**

UNIT II	CONCEPT GENERATION AND SELECTION	9
Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.		**CO2**

UNIT III	PRODUCT ARCHITECTURE	9
Implications – Product change – variety – component standardization – product performance –manufacturability – product development management – establishing the architecture – creation –clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.		**CO3**

UNIT IV	INDUSTRIAL DESIGN	9
Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools –Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven		**CO4**

products – assessing the quality of industrial design.		
UNIT V	**DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT**	**9**
Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs –Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes –Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.		**CO5**
		TOTAL : 45 PERIODS

TEXT BOOKS

1. Kari T.Ulrich and Steven D.Eppinger, "Product Design and Development", McGraw-Hill International Edns. 1999.

REFERENCE BOOKS

1. Kemnneth Crow, "Concurrent Engg./Integrated Product Development", DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, "Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New York, NY.

COURSE OUTCOMES

Upon completion of the course, students will be able to

CO1	Design some products for the given set of applications and also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.
CO2	Understand the concepts in generation and selection criteria.
CO3	Carry out pipeline execution and in establishing the architecture for developing products.
CO4	Acquire knowledge on investigation for customer needs related to industrialisation.
CO5	Develop and execute the developed prototypes.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	C	d	e	f	g	h	i	j	k	L	1	2	3
CO1	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO2	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO3	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2
CO4	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2

C05	2	1	3	1	2	2	2	1	1	1	1	2	2	3	2

OME107	VIBRATION AND NOISE CONTROL	L	T	P	C
		3	0	0	3

Objectives

- To study the basics, sources and its control techniques of vibration
- To study the basics, sources and its control techniques of noise
- To study the sources of vibration and noise in automobiles
- To reduce vibration and noise in automotive components

UNIT - I	BASICS OF VIBRATION	9
Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non-linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies.		CO1

UNIT - II	BASICS OF NOISE	9
Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.		CO2

UNIT - III	AUTOMOTIVE NOISE SOURCES	9
Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.		CO3

UNIT – IV	CONTROL TECHNIQUES	9
Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.		CO4

UNIT – V	SOURCE OF NOISE AND CONTROL	9
Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers		CO5

Total Periods: 45

Text Books:

1. Singiresu S.Rao, "Mechanical Vibrations", 5th Edition, Pearson Education, 2010.
2. David Bies and Colin Hansen, "Engineering Noise Control – Theory and Practice",4th Edition, E and FN Spon, Taylore & Francise, e-Library,2009.

Reference Books:

1. Benson H. Tongue, "Principles of Vibrations", 2nd Edition, Oxford University,2007.
2. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, "Theory of Vibration with Application", 5th Edition Pearson Education,2011.
3. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros., 1996.
4. Bernard Challen and Rodica Baranescu - "Diesel Engine Reference Book", Second Edition, SAE International,1999.
5. Julian Happian-Smith , "An Introduction to Modern Vehicle Design"- Butterworth-Heinemann, 2004.
6. Rao, J.S and Gupta, K., "Introductory course on Theory and Practice of Mechanical Vibration", 2nd Edition, New Age International Publications, 2010.
7. Shabana. A.A., "Theory of vibrations – An introduction", 2nd Edition, Springer,2010.
8. Balakumar Balachandran and Edward B. Magrab, "Fundamentals of Vibrations", 1st Editon, Cengage Learning, 2009.
9. John Fenton, "Handbook of Automotive body Construction and Design Analysis", Professional Engineering Publishing,1998.

Course Outcomes (CO)
Upon completion of the course, students will have the ability

CO1	To understand the basics, different types and source of vibration
CO2	To understand the basics, different types and source of noise
CO3	To understand and analyze the various sources of automotive noise
CO4	To understand the various control techniques of vibration
CO5	To understand the sources and control techniques of automotive noise

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	2	3	3	3	3	2	3	1	1	3	3	1	3	2	2
CO2	3	3	3	3	3	2	3	1	1	3	3	1	3	3	3
CO3	2	3	3	3	3	2	3	1	1	3	3	1	3	2	2

CO4	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3
CO5	2	3	3	3	3	2	3	1	1	3	3	1	3	3	3

OEC101	**INTRODUCTION TO SIGNALS AND SYSTEMS**	**L**	**T**	**P**	**C**
		3	0	0	3

Objectives

- To understand the basic properties of signal and systems
- To know the methods of characterization of LTI systems in the time domain
- To analyze continuous-time signals and system in the Fourier and Laplace domain
- To analyze discrete-time signals and system in the Fourier and Z transform domain

UNIT - I	**CLASSIFICATION OF SIGNALS AND SYSTEM**	**12**
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids - Classification of signals – Continuous-time (CT) and Discrete-time (DT) signals, Periodic and Aperiodic signals, Deterministic and Random signals, Energy and Power signals - Classification of systems- CT systems and DT systems- – Linear and Nonlinear, Time-variant and Time-invariant, Causal and Non- causal, Stable and Unstable.		**CO1**

UNIT - II	**ANALYSIS OF CONTINUOUS TIME SIGNALS**	**12**
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties.		**CO2**

UNIT - III	**LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS**	**12**
Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in analysis of CT systems - Systems connected in series and parallel.		**CO3**

UNIT-IV	**ANALYSIS OF DISCRETE TIME SIGNALS**	**12**
Baseband signal Sampling – Fourier Transform of discrete-time signals (DTFT) – Properties		**CO4**

of DTFT - Z Transform and Properties.		
UNIT - V	**LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS**	**12**
Impulse response – Difference equations-Convolution sum- Discrete-time Fourier Transform and Z Transform analysis of Recursive and Non-Recursive systems-DT systems connected in series and parallel.		**CO 5**
	Total Periods:	**60**

Text Books:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", Pearson, 2015.

Reference Books:

1. B. P. Lathi, "Principles of Linear Systems and Signals", Second Edition, Oxford,2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson,2007.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson,2007.

Course Outcomes (CO)

CO1	To be able to determine if a given system is linear/causal/stable
CO2	Capable of determining the frequency components present in a deterministic signal
CO3	Capable of characterizing LTI systems in the time domain and frequency domain
CO4	Understand the process of sampling and able to analyze the discrete-time signals in the frequency domain.
CO5	To be able to compute the output of an LTI system in the time and frequency domains.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1
CO2	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1

CO3	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1
CO4	3	2	3	3	2	2	0	0	0	0	1	2	2	2	1
CO5	3	2	3	3	2	2	0	0	0	0	1	2	3	2	1

OCH102	PROCESS MODELLING AND SIMULATION	L	T	P	C
	(COMMON TO EEE & EIE)	3	0	0	3

Objectives

- To give an overview of various methods of process modeling, different computational techniques for simulation.
- To analyze the steady state lumped systems.
- To analyze the unsteady state lumped systems
- To analyze the steady state distributed systems
- To analyze the unsteady state distributed systems and various modeling approaches.

UNIT – I	INTRODUCTION	7
Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.		**CO1**

UNIT – II	STEADY STATE LUMPED SYSTEMS	9
Degree of freedom analysis, single and network of process units, systems yielding linear and non- linear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.		**CO2**

UNIT – III	UNSTEADY STATE LUMPED SYSTEMS	9
Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.		**CO3**

UNIT – IV	STEADY STATE DISTRIBUTED SYSTEM	7
Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.		**CO4**

UNIT – V	UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES	13
Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling.		**CO5**

Total Periods:	**45**

Text Books:

1. Ramirez, W.; "Computational Methods in Process Simulation ", 2nd Education., Butterworths Publishers, New York,2000.
2. Luyben, W.L., " Process Modelling Simulation and Control ",2nd Education, McGraw-Hill Book Co., 1996

Reference Books:

1. Felder,R.M.andRousseau,R.W.,"Elementary Principles of Chemical Processes",John Wiley, Fourth edition 2018.
2. Franks, R. G. E., "Mathematical Modelling in Chemical Engineering ", John Wiley,2014.
3. Amiya K. Jana, "Process Simulation and Control Using ASPEN", 2nd Education,PHI Learning Ltd (2012).
4. Amiya K. Jana, "ChemicalProcess Modelling and Computer Simulation" 2nd Education,PHI Learning Ltd,(2012).

Course Outcomes (CO)

CO1	Student should have understood the development of process models based on conservation principles and process data and computational techniques to solve the process models.
CO2	Ability to analyze steady state lumped system
CO3	Ability to analyze unsteady state lumped system
CO4	Ability to analyze steady state distributed system
CO5	Ability to understand unsteady state distributed system and various modelling approaches

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	E	f	g	h	I	j	k	l	1	2	3
CO1	3	2	2	1	1	2	2	1	1	1	1	1	2	2	2
CO2	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2
CO3	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2

CO4	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2
CO5	3	3	3	3	2	2	2	1	2	1	1	1	3	3	2

OMB101	**TOTAL QUALITY MANAGEMENT**	**L**	**T**	**P**	**C**
(Common to Mechanical Engineering, Instrumentation and Control Engineering, Electronics and Instrumentation Engineering, Electronics and Communication Engineering, Computer Science Engineering, Information Technology, Civil Engineering)		3	0	0	3

Objectives

- 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		**CO1**

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.		**CO2**

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.		**CO3**

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.		**CO4**

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.		**CO5**

	Total Periods:	**45**

Text Books:

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 3rd Edition, Indian Reprint, Sixth impression, 2013.

Reference Books:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janaki Raman. 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. ISO 9001-2015 standards

Course Outcomes (CO)

CO1	The students can understand the principles of quality management and to explain how these principles can be applied within quality management systems.
CO2	Students can identify the key aspects of the quality improvement cycle and to select and use appropriate tools and techniques for controlling, improving and measuring quality.
CO3	Students can understand the organisational, communication and teamwork requirements for effective quality management
CO4	Critically analyse the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans
CO5	The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	4	0	0	0	0	4	4	4	4	4	4	4	0	0	0
CO2	3	0	0	0	0	4	4	4	4	4	4	4	0	0	0
CO3	4	0	0	0	0	3	4	4	3	3	4	4	0	0	0
CO4	4	0	0	0	0	3	4	3	3	3	4	4	0	0	0
C05	4	0	0	0	0	4	3	4	4	4	4	4	0	0	0

AUDIT COURSE

AD1001	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917and its impact on the initial drafting of the Indian Constitution.

UNIT – I	**HISTORY OF MAKING OF THE INDIAN CONSTITUTION**	**5**
History, Drafting Committee, (Composition & Working)		**CO1**
UNIT – II	**PHILOSOPHY OF THE INDIAN CONSTITUTION**	**5**
Preamble, Salient Features		**CO2**
UNIT – III	**CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES**	**5**
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.		**CO3**
UNIT – IV	**ORGANS OF GOVERNANCE**	**5**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.		**CO4**
UNIT – V	**LOCAL ADMINISTRATION**	**5**
District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.		**CO5**
UNIT – VI	**ELECTION COMMISSION**	**5**
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.		**CO5**
	Total Periods:	**30**

Reference Books:

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar 'Framing of Indian Constitution',1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edition, Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

Course Outcomes (CO)	
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution
CO4	Discuss the passage of the Hindu Code Bill of 1956.
CO5	Discuss about the role and functioning of election commission.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	3	2	1	1	1	1	1

AD1002	VALUE EDUCATION	L	T	P	C
		2	0	0	0

Objectives

· Understand value of education and self-development
· Imbibe good values in students
· Let the students know about the importance of character

UNIT – I		6
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements		CO1

UNIT – II		**6**
Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.		**CO2**
UNIT – III		**6**
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.		**CO3**
UNIT – IV		**6**
Character and Competence–Holy books vs Blind faith. Self-management and good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.		**CO4**
	Total Periods:	**30**

Reference Books:

1. Chakroborty, S.K.'Values and Ethics for organizations Theory and practice', Oxford University Press, New Delhi

Course Outcomes (CO)

CO1	Knowledge of self-development
CO2	Learn the importance of Human values
CO3	Developing the overall personality.
CO4	Developing the competence and self-control

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**1**	**2**	**3**
CO1	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	2	3	1	1	1	1	1

AD1003	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

Objectives

· Review existing evidence on their view topic to inform programme design and policy
· Making under taken by the DFID, other agencies and researchers.
· Identify critical evidence gaps to guide the development

UNIT – I	**INTRODUCTION AND METHODOLOGY**	**6**
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.		**CO1**
UNIT – II	**THEMATIC OVERVIEW**	**6**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries – Curriculum, Teacher education.		**CO2**
UNIT – III	**EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES**	**6**
Methodology for the in-depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.		**CO3**
UNIT – IV	**PROFESSIONAL DEVELOPMENT**	**6**
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes.		**CO4**
UNIT – V	**RESEARCH GAPS AND FUTURE DIRECTIONS**	**6**
Research design – Contexts – Pedagogy – Teacher education – Curriculum and assessment – Dissemination and research impact.		**CO5**
	Total Periods:	**30**

Reference Books:

1. J. Ackers, F. Hardman,'Classroom interaction in Kenyan primary schools', Compare, Vol. 31, No. 2, Page: 245-261, 2001.
2. M. Agrawal,'Curricular reform in schools: The importance of evaluation', Journal of Curriculum Studies, Vol. 36, No. 3, Page:361-379,2004.

3. K. Akyeampong,'Teacher training in Ghana-does it count? Multi-site teacher education research project' (MUSTER) Country report 1, London, 2003.
4. K. Akyeampong,K. Lussier, J. Pryor and J. Westbrook,'Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count?' International Journal Educational Development, Vol. 33, No. 3, Page: 272–282, 2013.
5. R. J. Alexander 'Culture and pedagogy: International comparisons in primary education', Oxford and Boston: Blackwell, 2001.
6. M. Chavan,'Read India: Amass scale, rapid, 'learning to read' campaign', 2003.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes (CO)

CO1	Students will be able to understand what pedagogical practices are being used by teachers in informal and informal classrooms in developing countries.
CO2	Students will be able to understand the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners.
CO3	Students will be able to understand how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
CO4	Students will be able to understand professional development, curriculum and assessment
CO5	Students will be able to understand the research design and its impact.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1
CO2	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1
CO3	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1
CO4	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1
CO5	1	1	1	1	1	1	1	1	2	2	1	2	1	1	1

AD1004	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

Objectives

- To achieve overall health of body and mind
- To overcome stress

UNIT – I		**10**
Definitions of Eight parts of yoga.(Ashtanga)		**CO1**
UNIT – II		**10**
Yam and Niyam – Do`s and Don't's in life – i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.		**CO2**
UNIT – III		**10**
Asan and Pranayam – Various yoga poses and their benefits for mind & body – Regularization of breathing techniques and its effects – Types of pranayam		**CO3**
	Total Periods:	**30**

Reference Books:

1. 'Yogic Asanas for Group Tarining-Part-I', Janardan Swami Yoga bhyasi Mandal, Nagpur.
2. 'Rajayoga or conquering the Internal Nature, by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

Course Outcomes (CO)

CO1	Students will be able to develop healthy mind in a healthy body thus improving social health also
CO2	Improve efficiency
CO3	Students will be able to understand effects of regularization of breathing techniques

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1

AD1005	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

Objectives		
· To learn to achieve the highest goal happily · To become a person with stable mind, pleasing personality and determination · To awaken wisdom in students		
UNIT – I		**10**
Neetisatakam– holistic development of personality – Verses-19,20,21,22 (wisdom) – Verses-29,31,32 (pride & heroism) – Verses-26,28,63,65 (virtue) – Verses-52,53,59 (dont's) – Verses-71,73,75,78 (do's)		**CO1**
UNIT – II		**10**
Approach to day-to-day work and duties – Shrimad Bhagwad Geeta: Chapter 2– Verses 41, 47,48 – Chapter 3– Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,1		**CO2**
UNIT – III		**10**
Statements of basic knowledge – Shrimad Bhagwad Geeta: Chapter2– Verses 56, 62, 68 Chapter 12 – Verses 13, 14, 15, 16,17, 18 – Personality of role model – Shrimad Bhagwad Geeta – Chapter2– Verses 17, Chapter 3– Verses 36,37,42 – Chapter 4– Verses 18, 38,39 Chapter18 – Verses 37,38,63		**CO3**
	Total Periods:	**30**

Reference Books:

1. Gopinath, P. Rashtriya Sanskrit Sansthanam, 'Bhartrihari's Three Satakam', Niti-sringar-vairagya, New Delhi,2010.
2. Swami Swarupananda, 'Srimad Bhagavad Gita', Advaita Ashram, Publication Department, Kolkata, 2016.

Course Outcomes (CO)

CO1	Students will be able to study the Shrimad-Bhagwad-Geeta that will help the student in developing his personality and achieve the highest goal in life
CO2	The person who has studied Geeta will lead the nation and mankind to peace and prosperity
CO3	Study of Neet is hatakam will help in developing versatile personality of students.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1

AD1006	UNNAT BHARAT ABHIYAN	L	T	P	C
		2	0	0	0

Objectives

- To engage the students in understanding rural realities
- To identify and select existing innovative technologies, enable customization of technologies, or devise implementation method for innovative solutions, as per the local needs.
- To leverage the knowledge base of the institutions to devise processes for effective implementation of various government programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and thereby improve quality of learning

UNIT - I	QUALITY OF RURAL LIFE IN VILLAGES AND UNNAT BHARAT ABHIYAN	9

Introduction to Unnat Bharat Abhiyan - concept, scope and objectives, rural life, rural society, cast and gender relations, rural values with respect to community, nature and resources, elaboration of "Soul of India lies in villages" – (Gandhi Ji), Rural infrastructure, problems in rural area. **CO1**

Assignment: Prepare a map (Physical , visual and digital) of the village you visited and write an essay about inter-family relation in that village.

UNIT - II	RURAL ECONOMY AND LIVELIHOOD	9

Agriculture, farming, land ownership pattern, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural market . **CO2**

Assignment: Describe your analysis of rural household economy, it's challenges and possible

pathways to address them. Group discussion in class- (4) Field visit 3.		
UNIT - III	**RURAL INSTITUTIONS**	**9**
History of Rural Development, Traditional rural organizations, Self Help Groups, Gram Swaraj and 3- Tier Panchayat Raj Institutions (Gram Sabha, Gram Panchayat, Standing Committee), local civil society, local administration. Introduction to Constitution, Constitutional Amendments in Panchayati Raj – Fundamental Rights and Directive Principles. **Assignment:** Panchayati Raj institutions in villages? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual). Field Visit – 4.		**CO3**
UNIT - IV	**RURAL DEVELOPMENT PROGRAMMES**	**9**
National programmes - Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swatchh Bharat, PM Awass Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc. **Written Assignment:** Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community, give suggestions about improving implementation of the programme for the rural poor.		**CO4**
UNIT - V	**FIELD WORK**	**9**
Each student selects one programme for field visit Field based practical activities: • Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities • Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the work site • Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures • Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP) • Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions regarding village development plan preparation and resource mobilization • Visit Rural Schools I mid-day meal centres, study Academic and infrastructural resources and gaps • Participate in Gram Sabha meetings, and study community participation		**CO5**

• Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries • Attend Parent Teacher Association meetings, and interview school drop outs • Visit local Anganwadi Centre and observe the services being provided • Visit local NGOs, civil society organisations and interact with their staff and beneficiaries. • Organize awareness programmes, health camps, Disability camps and cleanliness camps o Conduct soil health test, drinking water analysis, energy use and fuel efficiency surveys • Raise understanding of people's impacts of climate change, building up community's disaster preparedness • Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants • Formation of committees for common property resource management, village pond maintenance and fishing.	
Total Periods:	**45**

Text Books:

1. Singh, Katar, Rural Development Principles, Policies and Management, Sage Publications, New Delhi, 2015
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs

Reference Books:

1. M.P.Boraian, Best Practices in Rural Development, Shanlax Publishers
2. Unnat Bharat Abhiyan Website : www.unnatbharatabhiyan.gov.in

Course Outcomes (CO)

CO1	Able to understand of rural life, culture and social realities
CO2	Able to understand the concept of measurement by comparison or balance of parameters.
CO3	Able to develop a sense of empathy and bonds of mutuality with local community
CO4	Able to appreciate significant contributions of local communities to Indian society and economy
CO5	Learned to value the local knowledge and wisdom of the community

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1007	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		2	0	0	0

Objectives

- Get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India
- Understand education systems in India

UNIT - I	INTRODUCTION TO CULTURE	9
Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.		CO1

UNIT - II	INDIAN LANGUAGES AND LITERATURE	9
Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature		CO2

UNIT - III	RELIGION AND PHILOSOPHY	9
Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)		CO3

UNIT - IV	FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING)	9
Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India.		CO4

UNIT - V	EDUCATION SYSTEM IN INDIA	9
Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India		CO5

Total Periods:	45

Reference Books:

1. Kapil Kapoor, "Text and Interpretation: The India Tradition",ISBN: 81246033375, 2005
2. "Science in Samskrit", Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, "Position paper on Arts, Music, Dance and Theatre", ISBN 81-7450 494-X, 200
4. Narain, "Examinations in ancient India", Arya Book Depot, 1993
5. Satya Prakash, "Founders of Sciences in Ancient India", Vijay Kumar Publisher, 1989
6. M. Hiriyanna, "Essentials of Indian Philosophy", Motilal Banarsidass Publishers, ISBN 13: 978- 8120810990, 2014

Course Outcomes (CO)

CO1	Understand philosophy of Indian culture
CO2	Distinguish the Indian languages and literature
CO3	Learn the philosophy of ancient, medieval and modern India
CO4	Acquire the information about the fine arts in India. Know the contribution of scientists of different eras
CO5	Understand education systems in India

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

AD1008	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		2	0	0	0

Objectives

- Introduction to Sanga Tamil Literature.
- 'Agathinai' and'Purathinai' in SangaTamil Literature.
- 'Attruppadai' in SangaTamil Literature.
- 'Puranaanuru' in SangaTamil Literature.
- 'Pathitrupaththu' in SangaTamil Literature.

UNIT - I	**SANGA TAMIL LITERATURE AN INTRODUCTION**	**9**
Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's Grammar Tamil Sangam Literature's parables.		**CO1**
UNIT - II	**AGATHINAI AND PURATHINAI**	**9**
Tholkappiyar's Meaningful Verses –Three literature materials – Agathinai's message - History of Culture from Agathinai – Purathinai – Classification – Mesage to Society from Purathinai.		**CO2**
UNIT - III	**ATTRUPPADAI**	**9**
Attruppadai Literature – Attruppadai in'Puranaanuru' – Attruppadai in'Pathitrupaththu'- Attruppadai in 'Paththupaattu'.		**CO3**
UNIT - IV	**PURANAANURU**	**9**
Puranaanuru on Good Administration, Ruler and Subjects–Emotion & its Effect in Puranaanuru.		**CO4**
UNIT - V	**PATHITRUPATHTHU**	**9**
Pathitrupaththuin'Ettuthogai'–Pathitrupaththu'sParables–Tamildynasty:Valor, Administration, Charity in Pathitrupaththu - Mesaage to Society from Pathitrupaththu.		**CO5**
	Total Periods:	**45**

Text Books:

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. HankHeifetz andGeorgeL. Hart, The Puranануru,Penguin Books,2002.

Reference Books:

1. Kamil Zvelebil, The Smile of Murugan: OnTamil Literature of South India, Brill Academic Pub,1997.
2. GeorgeL. Hart, Poetsof theTamil Anthologies: AncientPoemsofLove andWar, Princeton University Press,2015.
3. XavierS.Thani Nayagam, Landscape and poetry:a study of nature in classical Tamil poetry,Asia Pub.House, 1967.

Course Outcomes (CO)

CO1	Appreciate and apply the messages in Sanga Tamil Literature in their life.
CO2	Differentiate 'Agathinai' and 'Purathinai' in their personal and societalife.
CO3	Appreciate and apply the messages in 'Attruppadai' in their personal and societalife.
CO4	Appreciate and apply the messages in 'Puranaanuru' in their personal and societallife.
CO5	Appreciate and apply the messages in 'Pathitrupaththu' in their personal and societallife.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	1	2	3
CO1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CO5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1