DEPARTMENT OF INSTRUMENTATION ENGINEERING
ANNA UNIVERSITY, CHENNAI

VISION OF THE DEPARTMENT

The Department of Instrumentation Engineering perseveres in becoming a Centre for Excellence in Electronics, Instrumentation and Control Engineering for Higher level learning, Research and Consultancy. The Department aims at imparting high quality education to students and professionals leading them to global competence. Its endeavors are to become a preferred partner to the industry and community for providing Engineering solutions.

MISSION OF THE DEPARTMENT

- Provide the students with strong foundation in Electronics, Instrumentation and ControlEngineering.
- Enhance the core competency of the students to cater to the needs of the industries andresearch organizations.
- Update the curriculum periodically and to upgrade the laboratories with state-of-art equipment.
- Encourage faculty members to keep abreast of current trends through continuing educationalprograms.
- Carry out interdisciplinary research and consultancy in the cutting-edge technology.

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UNIVERSITY DEPARTMENTS
B.E ELECTRONICS AND INSTRUMENTATION ENGINEERING
REGULATIONS – 2015
CHOICE BASED CREDIT SYSTEM

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Bachelor of Electronics and Instrumentation Engineering curriculum is designed to prepare the graduates to acquire knowledge, skills and attitudes in order to:

PEO1: Be successful in their technical, professional careers & in their chosen fields such as Electronics, Instrumentation, Process Control & Information Technology.

PEO2: Engross in the life long process of learning to keep themselves abreast of new developments in the emerging areas of Electronics, Instrumentation, Process Control & Information Technology.

PEO3: Sustain the highest integrity and social responsibility in all their endeavors.

PROGRAMME OUTCOMES

PO1: Engineering knowledge: Apply the knowledge of Mathematics, Science, Engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consi deration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a memberand leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs):

After completion of Electronics and Instrumentation Engineering program, students will gain core competency skills in domains such as Electronics, Instrumentation and Process control and

PSO1: Be able to Select, install, calibrate and maintain instruments used for measurement and analysis and interpret the data obtained to arrive at a significant conclusion.

PSO2: Be able to analyze, design and develop signal conditioning circuits for sensors, actuators and select a suitable Embedded System for realizing various control schemes and smart instruments.

PSO3: Be able to design, develop and implement control schemes for various industrial processes and gain hands on experience in configuring Industrial Automation System such as PLC and DCS.

PEO/PO Mapping:

PEO \ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
PEO 1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1
PEO 2	2	2	2	2	2	-	-	-	-	-	-	1	2	2	2
PEO 3	2	2	2	2	-	-	-	-	-	-	-	-	-	-	-

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SEMESTER	NAME OF THE SUBJECT	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES		
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO2
SEM I	**THEORY**															
	Foundational English	-	2	2.5	2.8	3	3	3	3	3	3	-	2.5	-	2	2
	Mathematics – I	2.6	3	2.4	2.2	2	1.6	1.2	-	1	1	1	1.2	2	2	2
	Engineering Physics	3	3	3	3	2	1	1	1	-	-	-	2	-	1.6	1.25
	Engineering Chemistry	3	2	1.4	1.4	2.2	-	-	-	1.4	1.5	-	-	-	1	2
	Computing Techniques	3	2.2	1.6	2	1.2	1.5	-	-	1	-	1	3	3	2.4	3
	PRACTICALS															
	Basic Sciences Laboratory	2.6	2.2	1.6	1.4	1.5	1	-	3	1.4	3	3	2	1	1.4	1.6
	Computer Practices Laboratory	2.8	2.6	1.6	1.4	1.2	1	2	3	2	3	3	3	3	1.6	1.4
SEM II	**THEORY**															
	Mathematics – II	2.6	3	2.8	2.2	1.8	1	1.5	1	-	-	1.5	1	2.2	2.6	1.6
	Material Science for Technologists	1	2	2	2	-	-	-	-	-	-	-	-	1	1	-
	Environmental Science and Engineering	2.4	2.2	1.8	-	1.6	2.4	3	2.4	-	2.6	-	-	-	2.3	2
	Signals and Systems	2.5	2.5	2	1.6	2	1.5	1	-	-	-	-	1.5	3	3	1
	Analysis of Electric Circuits	2.8	2.3	2.5	1.6	2.1	1	-	-	-	-	6	2.1	1	1.8	-
	Engineering	3	-	2.5	-	3	-	-	-	-	2	-	2	--	-	-

	Graphics															
	PRACTICALS															
	Engineering Practices Laboratory	-	-	-	-	-	-	-	3	-	3	3	-	-	-	-
	Circuit Simulation Laboratory	3	3	2	1.5	3	1	-	3	3	3	3	1	-	3	1.6
SEM III	Linear Algebra and Numerical Methods	2.6	2.4	1.6	1.3	3	1.2	2.2	1	1	1	2.2	2.6	2.4	2.8	1.6
	Fundamentals of Pneumatics & Hydraulics	3	2.2	2.4	1.8	2.4	1	1	1	1.2	2.8	2.4	2.4	2.6	3	2.6
	Electrical Machines	3	2.5	-	1.7	-	3	-	1	3	1	-	1.5	1.3	-	3
	Electronics for Analog Signal Processing - I	2.8	2	2.1	1.3	2.5	1	-	1.5	1	1.8	-	2.1	1.2	1.4	1
	Instrument Transducers	2.3	2.16	2.3	2	1.6	1.4	1	1	-	1	1	1	2	2	-
	Electrical and Electronic Measurements	2.5	2	2.5	3	-	2.5	2.5	2	2.5	2.5	1	2.5	2.5	-	-
	PRACTICALS															
	Electronics for Analog Signal Processing Laboratory	2.8	3	2.8	1.8	2.5	1	-	3	2.3	3	3	2.1	2.2	2.5	1.5
	Electrical Machines Laboratory	2.7	2.2	2.4	2	3	-	-	3	3	3	3	1	1	2	3
SEM IV	**THEORY**															

	Fundamentals of Thermodynamics & Fluid Mechanics	3	2	3	2	2	2	-	-	-	-	1	1	1	1	1
	Electronics for Analog Signal Processing – II	2.8	2	2	1.6	1.6	1	-	1.5	1	2.3	-	2.1	1.5	2.1	1.2
	Principles of Communication Engineering	3	2	1.6	1.1	1.1	1.8	-	-	-	1.3	1.6	-	1.6	1.3	-
	Digital Principles and Applications	2.6	2	2.6	2.6	-	2.6	2.3	2.3	2.3	2.6	1	2.6	-	2.6	-
	Industrial Instrumentation - I	2.4	2.4	2.4	2.4	2.2	2	1	1	1	1	1	1	1.6	1.8	1
	PRACTICALS															
	Sensors and Signal Conditioning Circuits Laboratory	2.5	2.7	2.2	2.6	2.2	-	-	3	3	3	3	1	1	2	3
	Digital System Design Laboratory	3	3	3	2.8	2.8	2.4	-	3	3	3	3	2	1.5	2.5	-
SEM V	**THEORY**															
	Fundamentals of Data Structures and Algorithms	3	1.7	1	1	-	-	-	-	2	1	-	-	2	3	2
	Microprocessors, Microcontrollers and Applications	3	2.1	2.3	2.3	2.3	1.5	1.2	1	1	2	1	3	1	1	1

	Industrial Instrumentation – II	2	1.8	1.8	2.1	-	1	1.5	1	-	-	-	1	2.8	-	-
	Control Systems	2.2	2.2	2.4	2.2	2	1	-	1	1	2	1	3	-	-	3
	PRACTICALS															
	Data Structures Laboratory	3	1.7	1	1	-	-	-	3	2	3	3	-	2	3	2
	Microprocessor and Interfacing Laboratory	3	2.3	2.5	2.6	3	2	1.3	3	1.2	3	3	3	1	1	1
SEM VI	**THEORY**															
	Project Management and Finance	3	2.5	1.3	-	-	1.6	-	2	2.6	1.8	3	3	2.2	-	-
	Discrete Time Signal Processing	2.6	2.5	1.6	2.6	2	1.5	2	-	-	-	-	1.6	2.3	3	1
	Process Control	1	1	1	1	1	-	-	-	-	-	-	-	-	1	-
	Employability skills	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3
	PRACTICALS															
	Industrial Instrumentation Laboratory	1	1	1	1	1.2	1	1	3	1	3	3	1.3	1	1	2
	Process Control Laboratory	1.2	1.4	1.5	1.3	1	1	1	3	1	3	3	2	1	1	-
SEM VII	**THEORY**															
	Computer Control of Processes`	3	2.5	2.8	-	3	2	1	1	-	1	-	2	2.7	-	3
	Logic and Distributed Control System	3	3	2	2	2.8	1.8	1	-	1	1	1	3	-	-	3
	PRACTICALS															
	Industrial	1.8	2.1	-	1	2.6	1.6	1.5	2	2.1	2.1	2.6	2	1.6	1.8	3

	Automation Laboratory															
	Instrumentation System Design Laboratory	3	3	3	2.2	3	1	1.4	3	2.2	3	3	1	2	3	3
	Mini Project / Industrial Training*/ Internship* * - (6weeks during summer vacation)	2	2	1.7	1.7	1	2	1	3	1	3	3	3	3	3	3
SEM VIII	**PRACTICALS**															
	Project work	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
ELECTIVES	**THEORY**															
	Analytical Instruments	2	2	1.5	1.5	2.5	1.6	1	1	1	1	1	1.16	1.16	1.16	1
	Industrial Data Communication	3	3	2.6	2.6	2.6	1	-	1	1	1.8	1	3	1	-	2.2
	Biomedical Instrumentation	2.1	1.5	2.1	1.6	1.8	2.5	1.8	1.3	2.1	1.5	-	1.6	3	1	-
	Fiber Optics and Laser Instrumentation	3	1	1	-	1.6	1	-	-	2	-	-	1.3	1	-	-
	Instrumentation in Petrochemical Industry	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
	Thermal Power Plant Instrumentation	3	1	3	1	1	2	2	1	-	1	-	-	2	-	-
	Nuclear Power Plant Instrumentation	3	3	2.8	2.3	1	1	1.8	1	1	1	1	3	1.5	3	2.2

	Safety Instrumented system	1.2	1	1.2	1.2	1	1	1	-	1	1.3	3	3	1.4	1.4	2
	Instrumentation Standards	2	1	1	1	1	1.5	1.5	2	2	2	-	-	2	-	-
	Unit Operations and Control	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
	Non-linear Control Systems	2.2	2.2	2.6	2.2	2	1	-	1	1	2	1	3	-	-	3
	Advanced Topics in PID Control	2	2.6	2.6	2.4	2.4	1	-	1	1	2	1	2.6	2	-	3
	Optimal Control	2.2	2.2	2.6	3	2	1	-	1	1	2	1	3	-	-	3
	State and Parameter Estimation	2.2	2.2	2.4	2.4	2.2	1	-	1	1	2	1	2.6	2	-	3
	Model Predictive Control	2	2.6	2.6	2.4	2.4	1	-	1	1	2	1	2.6	2	-	3
	Fault Detection and Diagnosis	2.2	2.4	2.6	3	2	1	-	1	1	2	1	3	2	-	1
	Power Electronics Drives and Control	1.8	1.8	2.6	1.2	1.8	-	-	-	-	-	1	1.8	-	1	1.5
	Fundamentals of Nano science and MEMS	3	1.5	1	-	1	-	-	-	-	-	-	1	1	2	-
	Microcontroller based System Design	3	2.6	2.5	2.8	2.5	2	1.2	1	1	2	1	3	1	1	1
	Applied Soft computing	2.8	2.6	2.5	2.6	2.6	1	-	1	1	2	1	3	2	3	3
	Engineering Ethics and Human Values	0.9	-	0.9	-	0.9	-	-	-	-	0.6	-	0.6	0.6	0.6	-

	Total quality Management	2	2	2.5	-	3	2.8	2	2	-	-	1.8	3	1.6	-	-
	Disaster Management	2	3	1.3	-	-	2.2	2	2.2	2.2	2	3	3	2.1	-	-
	Human Rights	2	1	1	1	1	1	2.4	1.8	-	-	-	-	-	-	1

ANNA UNIVERSITY, CHENNAI

UNIVERSITY DEPARTMENTS

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

REGULATIONS – 2015

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI I - VIII SEMESTERS

SEMESTER I

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	MA7151	Mathematics – I	BS	4	4	0	0	4
3.	PH7151	Engineering Physics	BS	3	3	0	0	3
4.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
5.	GE7151	Computing Techniques	ES	3	3	0	0	3
PRACTICALS								
6.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
7.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
TOTAL				**25**	**17**	**0**	**8**	**21**

SEMESTER II

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7251	Mathematics – II	BS	4	4	0	0	4
2.	PH7252	Materials Science for Technologists	BS	3	3	0	0	3
3.	GE7152	Engineering Graphics	ES	5	3	2	0	4
4.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
5.	EI7201	Analysis of Electric Circuits	ES	3	3	0	0	3

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6.	EI7251	Signals and Systems	ES	3	3	0	0	3
PRACTICALS								
7.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
8.	EI7211	Circuit Simulation Laboratory	ES	4	0	0	4	2
TOTAL				**29**	**19**	**2**	**8**	**24**

SEMESTER III

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7353	Linear Algebra and Numerical Methods	BS	4	4	0	0	4
2.	EI7301	Electrical and Electronic Measurements	PC	3	3	0	0	3
3.	EI7302	Electrical Machines	PC	3	3	0	0	3
4.	EI7303	Electronics for Analog Signal Processing I	PC	4	4	0	0	4
5.	EI7304	Fundamentals of Pneumatics and Hydraulics	ES	3	3	0	0	3
6.	EI7305	Instrument Transducers	PC	4	4	0	0	4
PRACTICALS								
7.	EI7311	Electrical Machines Laboratory	PC	4	0	0	4	2
8.	EI7312	Electronics for Analog Signal Processing Laboratory	PC	4	0	0	4	2
TOTAL				**29**	**21**	**0**	**8**	**25**

SEMESTER IV

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA7356	Probability and Random Processes	BS	4	4	0	0	4
2.	EI7401	Digital Principles and Applications	PC	3	3	0	0	3

3.	EI7402	Electronics for Analog Signal Processing II	PC	4	4	0	0	4
4.	EI7403	Fundamentals of Thermodynamics and Fluid Mechanics	ES	3	3	0	0	3
5.	EI7404	Industrial Instrumentation I	PC	3	3	0	0	3
6.	EI7405	Principles of Communication Engineering	PC	3	3	0	0	3
PRACTICALS								
7.	EI7411	Digital System Design Laboratory	PC	4	0	0	4	2
8.	EI7412	Sensors and Signal Conditioning Circuits Laboratory	PC	4	0	0	4	2
TOTAL				**28**	**20**	**0**	**8**	**24**

SEMESTER V

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI7501	Control Systems	PC	4	4	0	0	4
2.	EI7502	Fundamentals of Data Structures andAlgorithms	EEC	3	3	0	0	3
3.	EI7503	Industrial Instrumentation II	PC	3	3	0	0	3
4.	EI7504	Microprocessors, Microcontrollers and Applications	PC	3	3	0	0	3
5.		Professional ElectiveI	PE	3	3	0	0	3
6.		Open Elective I*	OE	3	3	0	0	3
PRACTICALS								
7.	EI7511	Data Structures Laboratory	EEC	4	0	0	4	2
8.	EI7512	Microprocessor and Interfacing Laboratory	PC	4	0	0	4	2
TOTAL				**27**	**19**	**0**	**8**	**23**

SEMESTER VI

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI7601	Discrete Time Signal Processing	PC	4	4	0	0	4
2.	EI7602	Process Control	PC	4	4	0	0	4
3.	EI7603	Project Management and Finance	HS	3	3	0	0	3
4.	HS7551	Employability skills	HS	3	3	0	0	3
5.		Professional ElectiveII	PE	3	3	0	0	3
6.		Open Elective II*	OE	3	3	0	0	3
PRACTICALS								
7.	EI7611	Industrial Instrumentation Laboratory	PC	4	0	0	4	2
8.	EI7612	Process Control Laboratory	PC	4	0	0	4	2
TOTAL				**28**	**20**	**0**	**8**	**24**

SEMESTER VII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	EI7701	Computer Control of Processes	PC	4	4	0	0	4
2.	EI7702	Logic and Distributed Control System	PC	3	3	0	0	3
3.		Professional ElectiveIII	PE	3	3	0	0	3
4.		Professional ElectiveIV	PE	3	3	0	0	3
5.		Open Elective III*	OE	3	3	0	0	3
PRACTICALS								
6.	EI7711	Industrial Automation Laboratory	PC	4	0	0	4	2
7.	EI7712	Instrumentation System Design Laboratory	PC	4	0	0	4	2

8.	EI7713	Mini Project / Industrial Training* / Internship* * - (6weeks during summer vacation) #	EEC	6	0	0	6	3
TOTAL				**30**	**16**	**0**	**14**	**23**

SEMESTER VIII

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective V	PE	3	3	0	0	3
2.		Professional Elective VI	PE	3	3	0	0	3
PRACTICALS								
3.	EI7811	Project work	EEC	20	0	0	20	10
TOTAL				**26**	**6**	**0**	**20**	**16**

TOTAL NO. OF CREDITS: 180

* Course from the curriculum of other UG programs

The Contact periods will not appear in the slot time table

HUMANITIES AND SOCIAL SCIENCES (HS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	HS7151	Foundational English	HS	4	4	0	0	4
2.	GE7251	Environmental Science and Engineering	HS	3	3	0	0	3
3.	HS7551	Employability skills	HS	3	3	0	0	3
4.	EI7603	Project Management and Finance	HS	3	3	0	0	3

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BASIC SCIENCES (BS)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA7151	Mathematics - I	BS	4	4	0	0	4
2.	PH7151	Engineering Physics	BS	3	3	0	0	3
3.	CY7151	Engineering Chemistry	BS	3	3	0	0	3
4.	BS7161	Basic Sciences Laboratory	BS	4	0	0	4	2
5.	MA7251	Mathematics - II	BS	4	4	0	0	4
6.	PH7252	Material Science for Technologists	BS	3	3	0	0	3
7.	MA7353	Linear Algebra and Numerical Methods	BS	4	4	0	0	4
8.	MA7356	Probability and Random Processes	BS	4	4	0	0	4

ENGINEERING SCIENCES (ES)

S.NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	GE7151	Computing Techniques	ES	3	3	0	0	3
2.	GE7161	Computer Practices Laboratory	ES	4	0	0	4	2
3.	EI7201	Analysis of Electric Circuits	ES	3	3	0	0	3
4.	EI7251	Signals and Systems	ES	3	3	0	0	3
5.	GE7152	Engineering Graphics	ES	5	3	2	0	4
6.	GE7162	Engineering Practices Laboratory	ES	4	0	0	4	2
7.	EI7211	Circuit Simulation Laboratory	ES	4	0	0	4	2
8.	EI7304	Fundamentals of Pneumatics and Hydraulics	ES	3	3	0	0	3
9.	EI7403	Fundamentals of Thermodynamics and Fluid Mechanics	ES	3	3	0	0	3

PROFESSIONAL CORE (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI7301	Electrical and Electronic Measurements	PC	3	3	0	0	3
2.	EI7302	Electrical Machines	PC	3	3	0	0	3
3.	EI7303	Electronics for Analog Signal Processing I	PC	4	4	0	0	4
4.	EI7305	Instrument transducers	PC	4	4	0	0	4
5.	EI7311	Electrical machines laboratory	PC	4	0	0	4	2
6.	EI7312	Electronics for Analog Signal Processing Laboratory	PC	4	0	0	4	2
7.	EI7401	Digital Principles and Applications	PC	3	3	0	0	3
8.	EI7402	Electronics for Analog Signal Processing II	PC	4	4	0	0	4
9.	EI7404	Industrial Instrumentation I	PC	3	3	0	0	3
10.	EI7405	Principles of Communication Engineering	PC	3	3	0	0	3
11.	EI7411	Digital System Design Lab	PC	4	0	0	4	2
12.	EI7412	Sensors and Signal Conditioning Circuits Laboratory	PC	4	0	0	4	2
13.	EI7501	Control Systems	PC	4	4	0	0	4
14.	EI7503	Industrial Instrumentation II	PC	3	3	0	0	3
15.	EI7504	Microprocessors, Microcontrollers and Applications	PC	3	3	0	0	3

16.	EI7512	Microprocessor and Interfacing Laboratory	PC	4	0	0	4	2
17.	EI7601	Discrete Time Signal Processing	PC	4	4	0	0	4
18.	EI7602	Process Control	PC	4	4	0	0	4
19.	EI7611	Industrial Instrumentation Laboratory	PC	4	0	0	4	2
20.	EI7612	Process Control Laboratory	PC	4	0	0	4	2
21.	EI7701	Computer Control of Processes	PC	4	4	0	0	4
22.	EI7702	Logic and Distributed Control System	PC	3	3	0	0	3
23.	EI7711	Industrial Automation Laboratory	PC	4	0	0	4	2
24.	EI7712	Instrumentation System Design Laboratory	PC	4	0	0	4	2

PROFESSIONAL ELECTIVES (PE)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI7001	Advanced Topics in PID Control	PE	3	3	0	0	3
2.	EI7002	Analytical Instruments	PE	3	3	0	0	3
3.	EI7003	Applied Soft Computing	PE	3	3	0	0	3
4.	EI7004	Biomedical Instrumentation	PE	3	3	0	0	3
5.	EI7005	Fault Detection and Diagnosis	PE	3	3	0	0	3

6.	EI7006	Fiber Optics and LaserInstrumentation	PE	3	3	0	0	3
7.	EI7007	Fundamentals of Nano Science and MEMS	PE	3	3	0	0	3
8.	EI7008	Instrumentation in Petrochemical Industry	PE	3	3	0	0	3
9.	EI7009	Instrumentation Standards	PE	3	3	0	0	3
10.	EI7010	Micro Controller BasedSystem Design	PE	3	3	0	0	3
11.	EI7011	Model Predictive Control	PE	3	3	0	0	3
12.	EI7012	Non-Linear Control Systems	PE	3	3	0	0	3
13.	EI7013	Nuclear Power Plant Instrumentation	PE	3	3	0	0	3
14.	EI7014	Optimal Control	PE	3	3	0	0	3
15.	EI7015	Power Electronics, Drives and Control	PE	3	3	0	0	3
16.	EI7016	Safety Instrumented System	PE	3	3	0	0	3
17.	EI7017	State and Parameter Estimation	PE	3	3	0	0	3
18.	EI7018	Thermal Power Plant Instrumentation	PE	3	3	0	0	3
19.	EI7019	Unit Operation sand Control	PE	3	3	0	0	3
20.	EI7071	Industrial Data Communication	PE	3	3	0	0	3
21.	GE7071	Disaster Management	PE	3	3	0	0	3
22.	GE7074	Human Rights	PE	3	3	0	0	3
23.	GE7351	Engineering Ethics and Human Values	PE	3	3	0	0	3

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24.	GE7652	Total Quality Management	PE	3	3	0	0	3
25.	GE7072	Foundation Skills in Integrated Product Development	PE	3	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	EI7502	Fundamentals of Data Structures andAlgorithms	EEC	3	3	0	0	3
2.	EI7511	Data Structures Laboratory	EEC	4	0	0	4	2
3.	EI7713	Mini Project / Industrial Training*/ Internship*	EEC	6	0	0	6	3
4.	EI7811	Project Work	EEC	20	0	0	20	10

* - (6weeks during summer vacation)

SUMMARY

S.NO.	SUBJECT AREA	CREDITS AS PER SEMESTER								CREDITS TOTAL
		I	II	III	IV	V	VI	VII	VIII	
1.	HS	4	3				6			13
2.	BS	12	7	4	4					27
3.	ES	5	14	3	3					25
4.	PC			18	17	12	12	11		70
5.	PE					3	3	6	6	18
6.	OE					3	3	3		9
7.	EEC					5		3	10	18
	Total	21	24	25	24	23	24	23	16	180
8.	Non-Credit/ Mandatory									

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HS7151 FOUNDATIONAL ENGLISH L T P C
4 0 0 4

COURSE DESCRIPTION:

This course aims at developing the language skills necessary for the first-year students of Engineering and Technology.

COURSE OBJECTIVES:

1. To develop the four language skills – Listening, Speaking, Reading and Writing.
2. To improve the students' communicative competence in English.
3. To teach students the various aspects of English language usage.

CONTENTS

UNIT I GREETING AND INTRODUCING ONESELF 12

Listening- Types of listening – Listening to short talks, conversations; Speaking – Speaking about one's place, important festivals etc. – Introducing oneself, one's family/ friend; **Reading** – Skimming a passage– Scanning for specific information; **Writing**- Guided writing - Free writing on any given topic (My favourite place/ Hobbies/ School life, writing about one's leisure time activities, hometown, etc.); **Grammar** – Tenses (present and present continuous) -Question types - Regular and irregular verbs; **Vocabulary** – Synonyms and Antonyms.

UNIT II GIVING INSTRUCTIONS AND DIRECTIONS 12

Listening – Listening and responding to instructions; **Speaking** – Telephone etiquette - Giving oral instructions/ Describing a process – Asking and answering questions; **Reading** – Reading and finding key information in a given text - Critical reading - **Writing –**Process description(non-technical)- **Grammar** – Tense (simple past& past continuous) - Use of imperatives – Subject – verb agreement – Active and passive voice; **- Vocabulary** – Compound words – Word formation – Word expansion(root words).

UNIT III READING AND UNDERSTANDING VISUAL MATERIAL 12

Listening- Listening to lectures/ talks and completing a task; **Speaking** –Role play/ Simulation – Group interaction; **Reading** – Reading and interpreting visual material; **Writing**- Jumbled sentences – Discourse markers and Cohesive devices – Essay writing (cause & effect/ narrative); **Grammar** – Tenses (perfect), Conditional clauses –Modal verbs; **Vocabulary** –Causeand effect words; Phrasal verbs in context.

UNIT IV CRITICAL READING AND WRITING 12

Listening- Watching videos/ documentaries and responding to questions based on them; **Speaking** Informal and formal conversation; **Reading** –Critical reading (prediction & inference); **Writing**–Essay writing (compare & contrast/ analytical) – Interpretation of visual materials; **Grammar** – Tenses (future time reference); **Vocabulary** – One word substitutes (with meanings) – Use of abbreviations & acronyms – Idioms in sentences.

UNIT V LETTER WRITING AND SENDING E-MAILS 12

Listening- Listening to programmes/broadcast/ telecast/ podcast; **Speaking** – Giving impromptu talks, Making presentations on given topics- Discussion on the presentation; **Reading** –Extensive reading; **Writing-** Poster making – Letter writing (Formal and E-mail); **Grammar** – Direct and Indirect speech – Combining sentences using connectives; **Vocabulary** –Collocation;

TEACHING METHODS:

Interactive sessions for the speaking module.
Use of audio – visual aids for the various listening activities.
Contextual Grammar Teaching.

EVALUATION PATTERN:

Internals – 50%
End Semester – 50%

TOTAL:60 PERIODS

COURSE OUTCOMES (CO):

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

1. Improve their reading and writing skills
2. Become fluent and proficient in communicative English
3. Improve their interpersonal communication
4. Have the capacity to discuss texts, verbally and in written form, with an independent intellectual perspective
5. Generate skills in communication through visual imagery and media

TEXTBOOK:

1. Richards, Jack. C with Jonathan Hull and Susan Proctor **New Interchange : English for International Communication. (level2, Student's Book)** Cambridge University Press, New Delhi: 2010.

REFERENCES:

1. Bailey, Stephen. **Academic Writing: A practical guide for students**. New York: Rutledge,2011.
2. Morgan, David and Nicholas Regan. **Take-Off: Technical English for Engineering**. London: Garnet Publishing Limited, 2008.

3. Redston, Chris & Gillies Cunningham **Face2Face** (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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO101.1	-	-	-	3	3	3	-	-	-	-	-	-	-	2	2
CO101.2	-	-	-	3	3	3	-	-	-	-	-	-	-	2	2
CO101.3	-	-	-	3	3	3	-	-	-	-	-	-	-	-	-
CO101.4	-	2	2	2	-	-	3	3	3	3	-	3	-	2	2
CO101.5	-	2	3	3	-	-	3	3	3	3	-	2	-	2	2
CO101	-	2	2.5	2.8	3	3	3	3	3	3	-	2.5	-	2	2

MA7151 MATHEMATICS – I L T P C
4 0 0 4

(Common to all branches of B.E. /B.Tech. Programmes in I Semester)

COURSE OBJECTIVES

1. The goal of this course is for students to gain proficiency in calculus computations. In calculus, we use three main tools for analyzing and describing the behavior of functions: limits, derivatives, and integrals. Students will use these tools to solve application problems in a variety of settings ranging from physics and biology to business and economics.
2. To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
3. To familiarize the student with functions of several variables. This is needed in many branches of engineering.
4. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I DIFFERENTIAL CALCULUS 12

Representation of functions - New functions from old functions - Limit of a function - Limits at infinity - Continuity - Derivatives - Differentiation rules - Polar coordinate system - Differentiation in polar coordinates - Maxima and Minima of functions of one variable.

UNIT II FUNCTIONS OF SEVERAL VARIABLES 12

Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Errors and approximations –

Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT III INTEGRAL CALCULUS 12

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

UNIT IV MULTIPLE INTEGRALS 12

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

UNIT V DIFFERENTIAL EQUATIONS 12

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

TOTAL : 60 PERIODS

COURSE OUTCOMES (CO):

1. Assimilate ideas of limits and continuity and an ability to calculate with them and apply them.
2. Improve the knowledge in algebraic manipulation.
3. Have fluency in differentiation
4. Have fluency in integration using standard methods, including the ability to find an appropriate method for a given integral.
5. Familiarize the ideas of differential equations and facility in solving simple standard examples.

TEXT BOOKS

1. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, New Delhi, 2008.
2. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
4. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES

1. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., New Delhi, 11th Reprint, 2010.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
3. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.

4. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 5th Reprint, 2009.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO102.1	2	3	1	1	2	-	1	-	1	1	1	2	3	1	2
CO102.2	3	3	3	2	2	-	-	-	-	-	1	1	1	2	2
CO102.3	3	3	3	3	2	1	1	-	-	-	1	1	2	2	2
CO102.4	2	3	3	2	1	2	1	-	-	-	1	1	2	3	2
CO102.5	3	3	2	3	3	2	2	-	-	-	-	1	2	2	2
CO102	2.6	3	2.4	2.2	2	1.6	1.2	-	1	1	1	1.2	2	2	2

PH7151 **ENGINEERING PHYSICS** **L T P C**

(Common to all branches of B.E / B.Tech programmes) **3 0 0 3**

COURSE OBJECTIVE:

1. To introduce the concept and different ways to determine moduli of elasticity and applications.
2. To instill the concept of sound, reverberation, noise cancellation, and ultrasonic generation, detection and applications.
3. To inculcate an idea of thermal properties of materials, heat flow through materials and quantum physics.
4. To promote the basic understanding of interferometers, principles and applications of lasers, optical fibers and sensors.

5. To establish a sound grasp of knowledge on the basics, significance and growth of single crystals

UNIT I PROPERTIES OF MATTER 9

Elasticity – Poisson's ratio and relationship between moduli (qualitative) - stress-strain diagram for ductile and brittle materials, uses - factors affecting elastic modulus and tensile strength - bending of beams - cantilever - bending moment - Young's modulus determination - theory and experiment - uniform and non-uniform bending - I shaped girders - twisting couple - hollow cylinder - shaft - torsion pendulum - determination of rigidity modulus- moment of inertia of a body (regular and irregular).

UNIT II ACOUSTICS AND ULTRASONICS 9

Classification of sound - loudness and intensity - Weber-Fechner Law - standard intensity and intensity level - decibel - reverberation - reverberation time - calculation of reverberation time for different types of buildings – sound absorbing materials - factors affecting acoustics of buildings : focussing, interference, echo, echelon effect, resonance - noise and their remedies. Ultrasonics: production - magnetostriction and piezoelectric methods - detection of ultrasound - acoustic grating – ultrasonic interferometer - industrial applications – Non-destructive testing - ultrasonic method: scan modes and practice.

UNIT III THERMAL AND MODERN PHYSICS 9

Thermal expansion - thermal stress - expansion joints - bimetallic strips - thermal conductivity- heat conductions in solids – flow of heat through compound media - Forbe's and Lee's disc method: theory and experiment- Black body radiation – Planck's theory (derivation) – Compton effect – wave model of radiation and matter – Schrödinger's wave equation – time dependent and independent equations – Physical significance of wave function – particle in a one dimensional box.

UNIT IV APPLIED OPTICS 9

Interference - Michelson interferometer: construction, working, determination of wave length and thickness - anti-reflection coating - air wedge and its applications - Lasers – principle and applications – Einstein's coefficients – CO_2 and Nd:YAG laser - semiconductor lasers: homo junction and hetro junction - construction and working – applications. Optical fibres - classification (index & mode based) - principle and propagation of light in optical fibres - acceptance angle and numerical aperture - fibre optic communication system - active and passive sensors.

UNIT V CRYSTAL PHYSICS 9

Single crystalline, polycrystalline and amorphous materials – Single crystals: unit cell, crystal systems, Bravais lattices, ditections and planes in a crystal, Miller indices - interplanar distance

for a cubic crystal - coordination number and packing factor for SC, BCC, FCC, HCP and diamond structures - structure and significance of NaCl, CsCl, ZnS and graphite - crystal imperfections: point defects, line defects – Burger vectors, dislocations and stacking faults – Growth of single crystals: Bridgman and Czochralski methods.

TOTAL: 45 PERIODS

COURSE OUTCOME(CO):

1. Understand different moduli of elasticity, their determination and applications.
2. Understand fundamental physical principles underlying the generation and propagation of sound waves in gas and liquid
3. Apply the knowledge of basic quantum mechanics, to set up one dimensional Schrodinger's wave equation and its application to matter wave system
4. Describe the basic laser physics, working of lasers, holography and principle of propagation of light in optical fibers Recognize various planes in a crystal and describe the structure determination using X-rays. growing single crystals.

TEXTBOOKS:

1. Gaur R.K. and Gupta S.L., "Engineering Physics", Dhanpat Rai Publications (2013)
2. Palanisamy P.K., "Engineering Physics", Scitech Publications (P) Ltd. (2006).
3. Arumugam M., "Engineering Physics", Anuradha Publications (2000)

REFERENCES:

1. Serway R.A. and Jewett, J.W. "Physics for Scientists and Engineers with Modern Physics". Brooks/cole Publishing Co. (2010).
2. Tipler P.A. and Mosca, G.P., "Physics for Scientists and Engineers with Modern Physics". W.H.Freeman, (2007).
3. Markert J.T.,Ohanian, H. and Ohanian, M. "Physics for Engineers and Scientists". W.W.Norton & Co. (2007).

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO103.1	3	3	3	3	2	1	1	1	-	-	-	2	-	2	1
CO103.2	3	3	3	3	2	1	1	1	-	-	-	2	-	2	-
CO103.3	3	3	3	3	2	1	1	1	-	-	-	2	-	2	1
CO103.4	3	3	3	3	2	1	1	1	-	-	-	2	-	1	2
CO103	3	3	3	3	2	1	1	1	-	-	-	2	-	1.6	1.25

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CY7151 ENGINEERING CHEMISTRY L T P C
3 0 0 3

COURSE OBJECTIVES

1. To develop an understanding about fundamentals of polymer chemistry.
2. Brief elucidation on surface chemistry and catalysis.
3. To develop sound knowledge photochemistry and spectroscopy.
4. To impart basic knowledge on chemical thermodynamics.
5. To understand the basic concepts of nano chemistry.

UNIT I POLYMER CHEMISTRY 9

Introduction: Functionality-degree of polymerization. Classification of polymers- natural and synthetic, thermoplastic and thermosetting. Types and mechanism of polymerization: addition (free radical, cationic, anionic and living); condensation and copolymerization. Properties of polymers: Tg, tacticity, molecular weight-weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension.

UNIT II SURFACE CHEMISTRYAND CATALYSIS 9

Adsorption-Types of adsorption-adsorptions of gases on solids- adsorption from solutions- Types of isotherms–Frendlich adsorption isotherm, Langmuir adsorption isotherm. Industrial applications of adsorption. Catalysis: Characteristics and types of catalysts-homogeneous and heterogeneous, auto catalysis. Enzyme catalysis -factors affecting enzyme catalysis, Michaelis-Menton equation. Industrial applications of catalysts.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry-Grotthuss-Draper law, Stark-Einstein law and LambertBeer Law. Photo processes-internal conversion, inter-system crossing, fluorescence, phosphorescence, chemiluminescence and photo-sensitization. Spectroscopy: Electromagnetic spectrum-absorption of radiation-electronic, vibrational and rotational transitions. Width and intensities of spectral lines.Spectrophotometric estimation of iron.UV-Vis and IR spectroscopy-principles, instrumentation (Block diagram) and applications.

UNIT IV CHEMICAL THERMODYNAMICS 9

Second law: Entropy-entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Free energy and work function: Helmholtzand Gibbs free energy functions; Criteria of spontaneity; Gibbs-Helmholtz equation; Clausius Clapeyron equation; Maxwell relationsVan't Hoff isotherm and isochore. Chemical potential; Gibbs-Duhem equation- variation of chemical potential with temperature and pressure.

UNIT V NANOCHEMISTRY 9

Basics-distinction between molecules, nanoparticles and bulk materials; size-dependent properties.Preparation of nanoparticles – sol-gel and solvothermal.Preparation of carbon nanotube by chemical vapour deposition and laser ablation.Preparation of nanowires by VLS growth, electrochemical deposition and electro spinning.Properties and uses of nanoparticles, nanoclusters, nanorods, nanotubes and nanowires.

TOTAL : 45 PERIODS

COURSE OUTCOMES(CO)

1. Get familiar with polymer chemistry, surface chemistry and catalysis.
2. Know the photochemistry, spectroscopy and chemical thermodynamics.
3. K now the fundamentals of nano chemistry.
4. Understand the modified chemical or physical properties of the nano structured material
5. Comprehend the concept pf structure and concept of polymers

TEXT BOOKS:

1. Jain P. C. & Monica Jain., "Engineering Chemistry", DhanpatRai Publishing Company (P) Ltd, New Delhi, 2014.
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2014

REFERENCES:

1. Pahari A., Chauhan B., "Engineering Chemistry", Firewall Media, New Delhi, 2012.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. AshimaSrivastava. Janhavi N N, Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
4. Vairam S., Kalyani P., Suba Ramesh., "Engineering Chemistry", Wiley India Pvt Ltd., New Delhi., 2011.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO104.1	3	2	1	1	3	-	-	-	2	2	-	-	-	1	2
CO104.2	3	1	2	2	3	-	-	-	2	1	-	-	-	1	2
CO104.3	3	2	1	1	2	-	-	-	1	-	-	-	-	1	2
CO104.4	3	3	1	2	-	-	-	-	1	-	-	-	-	1	2
CO104.5	3	2	2	1	1	-	-	-	1	-	-	-	-	1	2
CO104	3	2	1.4	1.4	2.2	-	-	-	1.4	1.5	-	-	-	1	2

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GE7151 **COMPUTING TECHNIQUES** **L T P C**
3 0 0 3

Common to all branches of Engineering and Technology

COURES OBJECTIVES:

1. To learn programming using a structured programming language.
2. To provide C programming exposure.
3. To introduce foundational concepts of computer programming to students of different branches of Engineering and Technology.

UNIT I INTRODUCTION **9**

Introduction to Computers – Computer Software – Computer Networks and Internet - Need for logical thinking – Problem formulation and development of simple programs - Pseudo code - Flow Chart and Algorithms.

UNIT II C PROGRAMMING BASICS **9**

Introduction to C programming – Fundamentals – Structure of a C program – Compilation and linking processes - Constants, Variables – Data Types – Expressions - Operators –Decision Making and Branching – Looping statements – Solving Simple Scientific and Statistical Problems.

UNIT III ARRAYS AND STRINGS **9**

Arrays – Initialization – Declaration – One dimensional and two dimensional arrays - Strings- String operations – String Arrays - simple programs- sorting- searching – matrix operations.

UNIT IV POINTERS **9**

Macros - Storage classes –Basic concepts of Pointers– Pointer arithmetic - Example Problems - Basic file operations

UNIT V FUNCTIONS AND USER DEFINED DATA TYPES **9**

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion –Enumerators – Structures - Unions

TOTAL : 45 PERIODS

COURES OUTCOMES(CO):

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

1. Write C program for simple applications
2. Formulate algorithm for simple problems
3. Analyze different data types and arrays
4. Perform simple search and sort.
5. Use programming language to solve problems.

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TEXT BOOKS

1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013
2. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
3. Yashavant P. Kanetkar. "Let Us C", BPB Publications, 2011.

REFERENCES

1. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
2. Byron S Gottfried, "Programming with C", Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. R.G. Dromey, "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO105.1	3	1	1	1	1	1	-	-	-	-	1	3	3	2	3
CO105.2	3	1	2	1	-	-	-	-	1	-	1	3	3	2	3
CO105.3	3	3	2	2	1	-	-	-	-	-	-	3	3	2	3
CO105.4	3	3	2	3	1	-	-	-	-	-	-	3	3	3	3
CO105.5	3	3	1	3	2	2	-	-	1	-	-	3	3	3	3
CO105	3	2.2	1.6	2	1.25	1.5	-	-	1	-	1	3	3	2.4	3

BS7161 **BASIC SCIENCES LABORATORY** **L T P C**

(Common to all branches of B.E. / B.Tech Programmes) **0 0 4 2**

COURES OBJECTIVE:

1. To inculcate experimental skills to test basic understanding of physics of materials including properties of matter.
2. To inculcate experimental skills to test basic understanding of thermal and optical properties.
3. To induce the students to familiarize with experimental determination of velocity of ultrasonic waves, band gap determination.
4. To induce the students to familiarize with experimental determination of viscosity of liquids.

PHYSICS LABORATORY: (Any Seven Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending - Determination of young's modulus
3. Uniform bending – Determination of young's modulus
4. Lee's disc Determination of thermal conductivity of a bad conductor

5. Potentiometer-Determination of thermo e.m.f of a thermocouple
6. Laser- Determination of the wave length of the laser using grating
7. Air wedge - Determination of thickness of a thin sheet/wire
8. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
9. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
10. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
11. Post office box -Determination of Band gap of a semiconductor.
12. Spectrometer- Determination of wavelength using gating.
13. Viscosity of liquids - Determination of co-efficient of viscosity of a liquid by Poiseuille‟s flow

CHEMISTRY LABORATORY:

(Minimum of 8 experiments to be conducted)

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

COURSE OUTCOMES(CO):

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

1. Use the different measuring devices and meters to record the data with precision
2. Identify the properties of liquids by applying various methods

Attested

3. Identify the properties of materials using the principles of optics and thermal physics
4. Apply different methods to record the contents of water sample
5. Record the phase changes of solid

TOTAL: 60 PERIODS

TEXTBOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (8^{TH} edition, 2014)
2. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO106.1	2	2	2	2	-	1	-	3	2	3	3	2	1	2	1
CO106.2	3	2	1	1	2	-	-	3	1	3	3			1	2
CO106.3	2	2	2	2	-	1	-	3	2	3	3	2		2	1
CO106.4	3	3	1	1	-	-	-	3	1	3	3			1	2
CO106.5	3	2	2	1	1	-	-	3	1	3	3			1	2
CO106	2.6	2.2	1.6	1.4	1.5	1	-	3	1.4	3	3	2	1	1.4	1.6

GE7161 COMPUTER PRACTICES LABORATORY L T P C
0 0 4 2

COURES OBJECTIVES

1. To search, generate and manipulate data.
2. To analyze, present and visualize data.
3. To understand the basic programming constructs and articulate how they are used to develop a program with a desired runtime execution flow.
4. To articulate where computer programs fit in the provision of computer-based solutions to real world problems.
5. To learn to use data structures.

LIST OF EXPERIMENT

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem-solving using decision making and looping.
6. Simple programming for one dimensional and two-dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions
9. Program using Recursive Function

10. Program using structures and unions.

TOTAL: 60 PERIODS

COURSE OUTCOMES(CO):

1. Write and compile programs using C programs.
2. Write program with the concept of Structured Programming
3. Identify suitable data structure for solving a problem
4. Demonstrate the use of conditional statement.
5. Create applications using user defined data structures and string functions

LABORATORY REQUIREMENTS FOR BATCH OF 30 STUDENTS

30 Systems with C compiler

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO107.1	3	3	1	1	1	-	2	3	-	3	3	3	3	1	1
CO107.2	3	2	1	1	1	-	-	3	-	3	3	3	3	1	1
CO107.3	3	3	2	2	2	1	-	3	2	3	3	3	3	3	1
CO107.4	2	2	1	1	-	-	-	3	-	3	3	3	3	1	1
CO107.5	3	3	3	2	1	-	-	3	2	3	3	3	3	2	3
CO107	2.8	2.6	1.6	1.4	1.25	1	2	3	2	3	3	3	3	1.6	1.4

MA7251 MATHEMATICS – II L T P C

4 0 0 4

(Common to all branches of B.E. /B.Tech. Programmes in II Semester)

COURSE OBJECTIVES

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2. To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
3. To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
4. To acquaint the students with Differential Equations which are significantly used in Engineering problems.
5. To make the students appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

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UNIT I MATRICES 12

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

UNIT II VECTOR CALCULUS 12

Gradient and directional derivative – Divergence and Curl – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTION 12

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

UNIT IV COMPLEX INTEGRATION 12

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORMS 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES(CO)

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

1. Evaluate real and complex integrals using the Cauchy integral formula and the residue theorem
2. Appreciate how complex methods can be used to prove some important theoretical results.
3. Evaluate line, surface and volume integrals in simple coordinate systems
4. Calculate grad, div and curl in Cartesian and other simple coordinate systems, and establish identities connecting these quantities

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5. Use Gauss, Stokes and Greens theorems to simplify calculations of integrals and prove simple results.

TEXT BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 9th Edition, New Delhi, 2014.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.

REFERENCES

1. Ramana, B.V. "Higher Engineering Mathematics", Tata McGraw Hill, New Delhi, 2010.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, New Delhi, 2007.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 3rd Edition, 2007.
4. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
5. Peter V. O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO108.1	2	3	2	2	2	1	-	-	-	-	-	1	2	2	1
CO108.2	3	3	3	2	2	1	-	-	-	-	-	-	2	3	1
CO108.3	3	3	3	3	1	1	2	-	-	-	1	1	2	3	2
CO108.4	2	3	3	2	2	1	1	1	-	-	-	1	2	2	2
CO108.5	3	3	3	2	2	-	-	-	-	-	1	1	3	3	2
CO108	2.6	3	2.8	2.2	1.8	1	1.5	1	-	-	1.5	1	2.2	2.6	1.6

PH7252 MATERIALS SCIENCE FOR TECHNOLOGISTS L T P C

3 0 0 3

(Common to E&I and Rubber and Plastics Technology Branches)

COURSE OBJECTIVE:

1. To make the students to understand the basics of phase diagrams and various crystal growth techniques
2. To equip the students to have a knowledge on different types of electron theory, basics of applied quantum mechanics and about superconductors
3. To introduce the importance of semiconducting materials, physics of semiconducting materials and applications of semiconductors in device fabrication

4. To familiarize the students to magnetic materials, theory and types of magnetizations, dielectric materials and their application.
5. To provide the students a sound platform towards learning about advanced materials and their applications.

UNIT I MATERIALS PREPARATION AND PROCESSING 9

Gibbs phase Rule – Phase Diagram – One component and multi component systems – Eutectic – peritectic – Eutectoid – Peritectoid – Invariant reactions – Lever Rule – Nucleation – homogeneous and heterogeneous nucleation – Free energy of formation of a critical nucleus – Nucleation rate – Experimental techniques of crystal growth – Czochralski, Bridgman, Flux, Solution, Vapour, Sol-gel - Hydrothermal – Epitaxy.

UNIT II CONDUCTING MATERIALS 9

Classical free electron theory of metals – quantum free electron theory - particle in a three dimensional box – degenerate state - electrons in a metal - Fermi distribution function – Density of energy states – effect of temperature on Fermi energy, Superconducting Phenomena, Properties of superconductors – Meissner effect and Isotope effect. Type I and Type II superconductors, High Tc superconductors – Magnetic levitation and SQUIDS.

UNIT III SEMICONDUCTING MATERIALS 9

Origin of band gap in solids (qualitative) - Concept of effective mass of electron and hole – Carrier concentration in an intrinsic semiconductor (derivation) – Fermi level – Variation of Fermi level with temperature – electrical conductivity – Band gap determination – Carrier concentration in n-type and p-type semiconductors (derivation) – Variation of Fermi level with temperature and impurity concentration – Compound semiconductors – Hall effect – Determination of Hall coefficient – Solar cells – LED and photodiode.

UNIT IV MAGNETIC AND DIELECTRIC MATERIALS 9

Introduction to magnetic materials - Domain theory of ferromagnetism, Hysteresis, Soft and Hard magnetic materials – Anti-ferromagnetic materials – Ferrites, Giant Magneto Resistance materials, Electronic, Ionic, Orientational and space charge polarization – Internal field and deduction of Clausius Mosotti equation – Dielectric loss – Different types of dielectric breakdown – Classification of insulating materials and their applications – Ferroelectric materials.

UNIT V NEW MATERIALS AND APPLICATIONS 9

Introduction to Ceramics and its applications - Ceramic Fibres - Fibre reinforced Plastics – Fibre reinforced Metal – Metallic glasses – Shape memory alloys – Copper base alloys – Nickel – Titanium alloys - Sensors and Actuators – Range - Accuracy Determination –- Photo detectors, Bio-sensors, Scintillation detectors (Position sensitive) – Renogram – Computed

Tomography Scan (CT Scan) - Magnetic Resonance Imaging (MRI) - Performance and Reliability testing.

TOTAL: 45 PERIODS

COURSE OUTCOME(CO):

Students will be able to

1. Acquire knowledge of phase diagram and important crystal growing techniques.
2. familiarize with conducting materials, and properties and applications of superconductors.
3. Gain knowledge on semiconducting materials based on energy level diagrams, its types, temperature effect. Also, fabrication methods for semiconductor devices will be understood.
4. Realize with theories of magnetic materials, understand the dielectric behavior of insulating materials and ferroelectric materials. familiarize with ceramics, FRP, shape memory alloys and important technological applications

REFERENCES:

1. Kumar.J., Moorthy Babu. S and Vasudevan. S., "Engineering Physics", Vijay Nicole Imprints (2006).
2. Palanisamy, P.K., "Materials Science", Scitech. (2013).
3. Gaur. R.K. and Gupta. S.L., "Engineering Physics", Dhanpat Rai Publications (2013).
4. Raghavan V., "Materials Science and Engineering", Prentice Hall of India (2007).
5. Arumugam M., "Biomedical Instrumentation", Anuradha Agencies (2003).

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO109.1	1	2	2	2	-	-	-	-	-	-	-	-	1	1	-
CO109.2	1	2	2	2	-	-	-	-	-	-	-	-	1	1	-
CO109.3	1	2	2	2	-	-	-	-	-	-	-	-	1	1	-
CO109.4	1	2	2	2	-	-	-	-	-	-	-	-	1	1	-
CO109	1	2	2	2	-	-	-	-	-	-	-	-	1	1	-

GE7152 ENGINEERING GRAPHICS **L T P C**

3 2 0 4

COURESE OBJECTIVES

1. To draw free hand sketches of basic geometrical shapes and multiple views of objects.
2. To draw orthographic projections of lines and planes.
3. To draw orthographic projections of solids.
4. To draw the development of surfaces of objects.
5. To draw isometric and perspective views of simple solids.

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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 FREE HANDSKETCHING **14**

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- Free hand sketching of multiple views from pictorial views of objects

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACES **14**

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 trapezoidal 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 **14**

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

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES **14**

Sectioning of 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. Development of lateral surfaces of solids with cut-outs and holes.

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS **15**

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 and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method and vanishing point method.

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) **3**

Introduction to drafting packages and demonstration of their use.

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L=45+T=30, TOTAL: 75 PERIODS

COURESE OUTCOMES(CO):

On Completion of the course the student will be able to

1. Perform free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines, planes and solids
3. Obtain development of surfaces.
4. Prepare isometric and perspective views of simple solids.
5. comprehend the different methods of Engineering drawing and apply suitably

TEXT BOOK:

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. K.R.Gopalakrishna., "Engineering Drawing" (Vol I&II combined) SubhasStores, Bangalore, 2007
2. Luzzader, Warren.J., and Duff,John M.,,'' Fundamentals of Engineering Drawingwith an introduction to Interactive Computer Graphics for Design and Production",Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
3. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2nd Edition, 2009
4. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P)Limited ,2008.
5. K. V.Natarajan, "A text book of Engineering Graphics", 28th Edition, Dhanalakshmi Publishers, Chennai, 2015.
6. BasantAgarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
7. N.S Parthasarathy and Vela Murali, " Engineering Drawing", Oxford University Press, 2015

Publication of Bureau of Indian Standards:

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

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either-or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.

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3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO110.1	3	-	-	-	3	-	-	-	-	2	-	2	2	3	2
CO110.2	3	-	-	-	-	-	-	-	-	2	-	2	2	2	-
CO110.3	3	-	-	-	3	-	-	-	-	2	-	2	2	2	-
CO110.4	3	-	2	-	3	-	-	-	-	2	-	2	2	2	-
CO110.5	3	-	3	-	3	-	-	-	-	2	-	2	2	2	-
CO110	3	-	2.5	-	3	-	-	-	-	2	-	2	2	2.2	2

GE7251 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

COURESE OBJECTIVES:

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

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

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

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Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

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

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

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

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

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

TOTAL : 45 PERIODS

COURSE OUTCOMES(CO):

1. Have public awareness of environment at infant stage.
2. Suggest solutions to control pollution
3. Analyze the impact of deforestation.
4. Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
5. Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.

TEXTBOOKS:

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

REFERENCES:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia',Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi,2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO111.1	1	2	2	-	2	3	3	3	-	3	-	-	-	1	-
CO111.2	3	2	2	-	2	3	3	2	-	3	-	-	-	3	-
CO111.3	3	3	1	-	2	2	3	2	-	3	-	-	-	3	-
CO111.4	3	2	2	-	1	2	3	3	-	2	-	-	-	-	2
CO111.5	2	2	2	-	1	2	3	2	-	2	-	-	-	-	2
CO111	2.4	2.2	1.8	-	1.6	2.4	3	2.4	-	2.6	-	-	-	2.3	2

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EI7201 **ANALYSIS OF ELECTRIC CIRCUITS** **L T P C**
3 0 0 3

COURSE OBJECTIVES

1. To introduce basic concepts of AC and DC circuits and to explore the basics of R,L, C circuits.
2. To introduce various network theorems.
3. To introduce the concept of transient analysis of first and second order linear circuits.
4. To make the students understand the concept of resonance in Series and Parallel circuits.
5. To introduce the concept of two port networks and the analysis of three-phase balanced and unbalanced circuits.

UNIT I D.C and A.C CIRCUIT FUNDAMENTALS **8**

Linear, Nonlinear, Unilateral, Bilateral, Active and Passive elements. Voltage and Current sources:Ideal, Practical, Dependent and Independent. Laws:- Ohm's and Kirchhoff's Laws. Sinusoidal and other periodic waveforms:–Average and RMS value, Form factor. Phasor representation of A.C quantities:-Current and Voltage relationship in R, L, and C circuits, Impedance and admittance, Series and Parallel connections of resistances and impedances Y-Δ transformation, Voltage and Current division in series and parallel circuits. Power:- Real, Reactive, Complex and Apparent power, Power factor.

UNIT II STEADY STATE ANALYSIS OF NETWORKS **10**

Analysis of simple RC, RL and RLC circuits and phasor diagrams. Network reduction:-Mesh and Nodal analysis of D.C and A.C circuits. Theorems for D.C and A.C networks:-Superposition, Thevenin's, Norton's, Maximum Power Transfer and Reciprocity.

UNIT III TRANSIENT ANALYSIS OF FIRST AND SECOND ORDER LINEAR CIRCUITS **9**

Source free RC,RL,RLC Circuit responses. Standard test signals. Step response of RC, RL,RLC series and parallel circuits. Responses of RC, RL and RLC series circuits to sinusoidal excitation.

UNIT IV RESONANCE AND COUPLED CIRCUITS **8**

Locus diagrams. Resonance in parallel and series circuits: – Half power frequencies, Bandwidth, Quality and Dissipation factor. Self and Mutual Inductance in coupled coils :- Dot convention, Coefficient of coupling. Sinusoidal steady state analysis of network with coupled inductance.

UNIT V THREE PHASE CIRCUITS AND TWO PORT NETWORKS **10**

Three phase balanced and unbalanced voltage sources and loads:– Line voltage, Phase voltage, Phasor diagram, power and Power factor in three -phase circuit. Analysis with star and delta balanced and unbalanced loads. Network terminals and ports: – Z-parameters, T-equivalent of

reciprocal network, Y-parameter, π-equivalent of reciprocal networks, h-parameters and g-parameters.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

At the end of the course, the students will

1. Ability to systematically obtain the equations that characterize the performance of an electric circuit as well as solving both single phase and three-phase circuits.
2. Ability to reduce complex network into simplified network.
3. Ability to determine the time & frequency responses of RL, RC and RLC circuits.
4. Ability to obtain the circuit parameters, current, voltage and power of a network.
5. Ability to use the software tools such as Pspice, Matlab, Circuit Wizard, etc. for solving complex networks.
6. Ability to Identify, formulate, and solve engineering problems in the area circuits and systems.

TEXT BOOKS

1. Boylsted, R.L., "Introductory Circuit Analysis", 12th Edition, Prentice Hall, 2010.
2. Husain, A., "Networks and Systems", 2nd Edition Khanna Publishers, 2006.

REFERENCES

1. Edminister, J.A. and Nahvi, M., "Electric Circuits", 6thEdition, Schaum's Outline series, McGraw-Hill, 2013.
2. HAYT, Jr.W.H.,Kemmerly, J.E., and Durbin, S.M., "Engineering Circuit Analysis", 7th edition,McGraw-Hill, 2007.
3. Alexander, C.K., Matthew, N.O., and Sadiku, "Fundamentals of Electric Circuits", McGraw-Hill, 2007.
4. Decarlo, R.A. and Lin, P.M., "Linear Circuit Analysis", 2nd Edition,Oxford University Press.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO112.1	3	3	2	1	2	1	-	-	-	-	1	2	1	2	-
CO112.2	3	3	3	2	2	1	-	-	-	-	1	2	-	2	-
CO112.3	3	2	3	2	2	1	-	-	-	-	1	2	-	2	-
CO112.4	3	2	3	2	2	1	-	-	-	-	1	2	-	2	-
CO112.5	2	1	1	1	3	1	-	-	-	-	1	3	-	2	-
CO112.6	3	3	3	2	2	1	-	-	-	-	1	2	-	1	-
CO112	2.8	2.3	2.5	1.6	2.1	1	-	-	-	-	6	2.1	1	1.8	-

Attested

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EI7251 SIGNALS AND SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce the representation and classification of continuous-time and discrete-time signals.
2. To impart knowledge on the methods and impact of analog to digital conversion and digital to analog conversion.
3. To teach the analysis of CT and DT systems through various transform techniques such as Laplace transform, Fourier transform and Z-transform.
4. To familiarize the concept of random signals and their statistical properties.

UNIT I INTRODUCTION TO CT SIGNALS AND SYSTEMS 9

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

UNIT II ANALYSIS OF CT SIGNALS AND SYSTEMS 9

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

UNIT III DISCRETIZATION AND SIGNAL RECONSTRUCTION 9

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

UNIT IV CLASSIFICATION AND ANALYSIS OF DISCRETE TIME SIGNALS 9

DT signals: – Introduction, Definition, Elementary DT signals, Characterization. DT systems: Definition, Classification, Characterization. Time domain analysis: - Solutions of difference equations.

UNIT V TRANSFORM TECHNIQUES FOR DT SIGNALS AND SYSTEMS 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

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

1. Ability to remember the fundamentals of CT and DT signals and Systems
2. Ability to understand the classifications of CT and DT signals and Systems
3. Ability to apply the mathematical tools for characterizing various CT and DT signals and Systems
4. Ability to analyze the given signal or system in time as well as frequency domain
5. Ability to evaluate the characteristics of a given CT or DT system
6. Ability to solve complex problems in the analysis of CT and DT signals and Systems

TEXT BOOKS

1. Allan V. Oppenheim, S. Wilsky and S.H.Nawab, Signals and Systems, Pearson Education, Indian Reprint, 2007.
2. Tarun Kumar Rawat, Signals and Systems,Oxford University Press,2010
3. Arun K Tangirala, Principles of system identification, CRC press 2015

REFERENCES

1. H P Hsu, Signals and Systems, Schaum's Outlines, Tata McGraw Hill,2006.
2. John Alan Stuller, An Introduction to signals and Systems, Thomson, 2007.
3. Edward W Kamen,Bonnie S Heck, Fundamentals of Signals and Systems using the Web and MATLAB, Pearson, Indian Reprint,2007.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO113.1	3	3	-	1	1	-	-	-	-	-	-	1	-	-	-
CO113.2	2	2	-	1	1	1	-	-	-	-	-	1	3	-	-
CO113.3	3	2	-	1	3	-	-	-	-	-	-	2	-	3	-
CO113.4	2	3	-	2	2	-	-	-	-	-	-	1	-	-	-
CO113.5	2	2	1	2	2	-	1	-	-	-	-	1	-	-	1
CO113.6	3	3	3	3	3	2	-	-	-	-	-	3	3	3	1
CO113	2.5	2.5	2	1.6	2	1.5	1	-	-	-	-	1.5	3	3	1

GE7162 ENGINEERING PRACTICES LABORATORY

(Common to all Branches of B.E. / B.Tech. Programmes) **L T P C**

0 0 4 2

COURSE OBJECTIVES

To provide exposure to the students with hands-on experience on various Basic Engineering Practices in Civil, Mechanical, Electrical and Electronics Engineering. 37

GROUP – A (CIVIL & ELECTRICAL)

CIVIL ENGINEERING PRACTICES 15

PLUMBING

• Basic pipe connections involving the fittings like valves, taps, coupling, unions, reducers, elbows and other components used in household fittings. Preparation of plumbing line sketches.

• Laying pipe connection to the suction side of a pump.

• Laying pipe connection to the delivery side of a pump.

• Practice in connecting pipes of different materials: Metal, plastic and flexible pipes used in house hold appliances.

WOOD WORK

• Sawing, planning and making joints like T-Joint, Mortise and Tenon joint and Dovetail joint.STUDY

• Study of joints in door panels and wooden furniture

• Study of common industrial trusses using models.

ELECTRICAL ENGINEERING PRACTICES 15

• Basic household wiring using Switches, Fuse, Indicator and Lamp etc.,

• Stair case light wiring

• Tube – light wiring

• Preparation of wiring diagrams for a given situation.

• Study of Iron-Box, Fan Regulator and Emergency LampGROUP – B (MECHANICAL AND ELECTRONICS) MECHANICAL ENGINEERING PRACTICES 15 WELDING

• Arc welding of Butt Joints, Lap Joints, and Tee Joints

• Gas welding Practice.

• Basic Machining - Simple turning, drilling and tapping operations.

• Study and assembling of the following:

a. Centrifugal pump

b. Mixie

c. Air Conditioner.

DEMONSTRATION ON FOUNDRY OPERATIONS.

ELECTRONIC ENGINEERING PRACTICES 15

• Soldering simple electronic circuits and checking continuity.

• Assembling electronic components on a small PCB and Testing.

Attested

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• Study of Telephone, FM radio and Low Voltage Power supplies.

TOTAL : 60 PERIODS

COURSE OUTCOMES

1. Ability to fabricate carpentry components and to lay pipe connections including plumbing works.
2. Ability to use welding equipment to join the structures
3. Ability to do wiring for electrical connections and to fabricate electronics circuits.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO114.1								3		3	3				
CO114.2								3		3	3				
CO114.3								3		3	3				
CO114								3		3	3				

EI7211 CIRCUIT SIMULATION LABORATORY L T P C

0 0 4 2

COURSE OBJECTIVES

1. To learn and practice generation and characterization of continuous and discrete time signals
2. To analyze time and frequency response of DT signals
3. To explore various network theorems using simulation software.

LIST OF EXPERIMENT 2

1. Generation of Continuous Time(CT) and Discrete Time (DT) signals
   (i) Standard signals: – impulse, step, ramp, exponential
   (ii) Periodic and a-periodic signals (iiii) Deterministic and random signals
2. CT and DT system characterization:
   (i) Linearity
   (ii) Time invariance
   (iii) Causality
   (iv) Stability
3. Time response & Frequency response of DT systems
4. Discretization and Reconstruction of signals
   (i) Sampling and aliasing effects (ii) A/D conversion (iii) D/A conversion
5. Statistical analysis of random signals

6. Verification Kirchhoff's laws, Thevenin's and Norton's theorems.

7. Verification of Superposition, Maximum Power transfer and Reciprocity theorems.

8. Response of RL, RC and RLC circuits for step input.

9. Frequency response of Series and Parallel resonance circuits.

10. Determination of self and mutual inductances and coupling coefficient of coupled coils.

11. Power and power factor measurement in three phase circuits by two wattmeter method.

12. Determination of Z, Y and h parameters of a two port network.

TOTAL : 60 PERIODS

COURSE OUTCOMES

At the end of the course, the students

1. Generate / characterize CT and DT signals using simulation software tools
2. Analyze CT and DT systems using software simulation tools and determine the response of systems using Time and Frequency domain analysis
3. Verify the network theorems by simulating the electrical circuits and determine the
4. Determine Z, Y and h parameters of a two port network and also verify the transient response and frequency response of circuits through simulation
5. Perform simulation studies on resonant circuits, coupled coils and three phase circuits
6. Design DT system for a given set of specifications using software tool such as Matlab
7. Design electric circuits for a given set of specifications using software tool such as Proteus
8. Perform hardware experiments in electric circuit analysis and verify the results against simulation results

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO115.1	3	3	2	1	3	-	-	**3**	3	**3**	**3**	1	-	3	1
CO115.2	3	3	2	1	3	-	-	**3**	3	**3**	**3**	1	-	3	1
CO115.3	3	3	2	1	3	-	-	**3**	3	**3**	**3**	1	-	3	1
CO115.4	3	3	2	1	3	-	-	**3**	3	**3**	**3**	1	-	3	1
CO115.5	3	3	2	1	3	-	-	**3**	3	**3**	**3**	1	-	3	1
CO115.6	3	3	2	3	3	1	-	**3**	3	**3**	**3**	1	-	3	3
CO115.7	3	3	2	3	3	1	-	**3**	3	**3**	**3**	1	-	3	3
CO115.8	3	3	2	1	3	-	-	**3**	3	**3**	**3**	1	-	3	2
CO115	3	3	2	1.5	3	1	-	**3**	3	**3**	**3**	1	-	3	1.6

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MA7353 LINEAR ALGEBRA AND NUMERICAL METHODS L T P C
(Branch specific course) 4 0 0 4

COURSE OBJECTIVES:

The basic concepts and tools of the subject covered are:

1. Solving systems of linear equations, Matrix operations.
2. Vector spaces and subspaces; linear independence and span of a set of vectors, basis and dimension; the standard bases for common vector spaces.
3. Inner product spaces: Cauchy-Schwarz inequality, orthonormal bases, the Gramm Schmidt procedure, orthogonal complement of a subspace, orthogonal projection.
4. Linear Transformations: kernel and range of a linear transformation, the Rank- Nullity Theorem, linear transformations and matrices, change of basis, similarity of matrices.
5. Eigenvalues and eigenvectors, diagonalizability of a real symmetric matrix, canonical forms.
6. Mathematical foundations of numerical techniques for solving linear system, eigenvalue problems and generalized inverses.

UNIT I VECTOR SPACES 12

Vector spaces – Subspaces – Linear combinations and Linear system of equations – Linear independence and Linear dependence – Bases and Dimensions.

UNIT II LINEAR TRANSFORMATION AND DIAGONALIZATION 12

Linear transformation - Null spaces and Ranges - Dimension theorem - Matrix representation of a Linear transformations - Eigenvalues and eigenvectors - Diagonalizability.

UNIT III INNER PRODUCT SPACES 12

Inner product, norms - Gram-Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

UNIT IV NUMERICAL SOLUTION OF LINEAR SYSTEM OF EQUATIONS 12

Solution of linear system of equations – Direct method: Gauss elimination method – Pivoting – GaussJordan method - LU decomposition method – Cholesky decomposition method - Iterative methods: Gauss-Jacobi and Gauss-Seidel – SOR Method.

UNIT V NUMERICAL SOLUTION OF EIGENVALUE PROBLEMS AND GENERALISED INVERSES 12

Eigenvalue Problems: Power method – Jacobi's rotation method – Conjugate gradient method – QR decomposition - Singular value decomposition method.

TOTAL: 60 PERIODS

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COURSE OUTCOMES

1. The students can able to solve system of linear equations, to use matrix operations and vector spaces using algebraic methods.
2. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
3. Apply numerical methods to obtain approximate solutions to mathematical problems.
4. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
5. Analyse and evaluate the accuracy of common numerical methods.

TEXT BOOKS:

1. Friedberg, A.H., Insel, A.J. and Spence, L., "Linear Algebra", Prentice - Hall of India, New Delhi, 2004.
2. Faires, J.D. and Burden, R., "Numerical Methods", Brooks/Cole (Thomson Publications), New Delhi, 2002.
3. Richard Branson, "Matrix Operations", Schaum's outline series, 1989.

REFERENCES:

1. Kumaresan, S., "Linear Algebra – A geometric approach", Prentice – Hall of India, New Delhi, Reprint, 2010.
2. Strang, G., "Linear Algebra and its applications", Thomson (Brooks/Cole), New Delhi, 2005.
3. Gerald, C.F, and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education, New Delhi, 2002.
4. Sundarapandian. V, "Numerical Linear Algebra", Prentice – Hall of India, New Delhi, 2008. 5. Bernard Kolman, David R. Hill, "Introductory Linear Algebra", Pearson Education, New Delhi, First Reprint, 2009.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO201.1	3	1	2	-	-	-	2	1	-	1	2	2	2	2	1
CO201.2	3	3	1	1	3	1	2	1	1	1	2	2	3	3	1
CO201.3	2	3	2	1	3	1	3	1	1	1	2	3	3	3	1
CO201.4	2	3	2	2	3	2	2	1	1	1	2	3	2	3	2
CO201.5	3	2	1	-	3	1	2	1	1	1	3	3	2	3	3
CO201	2.6	2.4	1.6	1.3	3	1.2	2.2	1	1	1	2.2	2.6	2.4	2.8	1.6

Attested

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EI7301 ELECTRICAL AND ELECTRONIC MEASUREMENTS LT P C
3 0 0 3

COURSE OBJECTIVES

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

UNIT I MEASUREMENT OF ELECTRICAL PARAMETERS 9

Types of ammeters and voltmeters: PMMC Instruments, Moving Iron Instruments, Dynamometer type Instruments – Resistance measurement: Wheatstone bridge, Kelvin double bridge and Direct deflection methods. Measurement of Inductance: Maxwell-Wein Bridge, Hay's bridge and Anderson Bridge - Measurement of Capacitance: Schering Bridge.

UNIT II POWER AND ENERGY MEASUREMENTS 9

Electro-dynamic type wattmeter: Theory and its errors – LPF wattmeter – Phantom loading – Single phase Induction type energy meter: Theory and Adjustments – 3 phase induction energy meter and phase measurement– Calibration of wattmeter and Energy meters – Synchroscope.

UNIT III POTENTIOMETERS AND INSTRUMENT TRANSFORMERS 9

D.C. Potentiometers: Student type potentiometer, Precision potentiometer – A.C. Potentiometers: Polar and Coordinate types – Applications – Instrument Transformer: Construction and theory of Current Transformers and Potential Transformers.

UNIT IV ANALOG AND DIGITAL INSTRUMENTS 9

Wave analyzers – Signal and function generators – Distortion factor meter – Q meter – Digital voltmeter and multi-meter – Microprocessor based DMM with auto ranging and self diagnostic features – Frequency measurement.

UNIT V DISPLAY AND RECORDING DEVICES 9

Cathode ray oscilloscope: Classification, Sampling and storage scopes – LED, LCD and dot matrix displays –Trends in display technologies – X-Y recorders – Magnetic tape recorders – Digital Data Recording –Digital memory waveform recorder – Data loggers.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. 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.
2. An ability to choose suitable AC and DC bridge for measuring R, L, C and frequency for the required specifications
3. An ability to apply knowledge of electronic instrumentation for measurement of electrical quantities.
4. Able to apply the principles and practices for instrument design and development to real world problems.
5. Ability to analyze and store the signals using various display and recording devices.
6. Ability to suggest the kind of instrument appropriate for typical measurements.

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

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO202.1	2	2	2	3	-	2	3	3	3	2	1	2	2	-	-
CO202.2	3	2	3	3	-	3	2	1	2	3	1	3	3	-	-
CO202.3	2	2	2	3	-	2	3	3	3	2	1	2	2	-	-
CO202.4	3	2	3	3	-	3	2	1	2	3	1	3	3	-	-
CO202.5	2	2	2	3	-	2	3	3	3	2	1	2	2	-	-
CO202.6	3	2	3	3	-	3	2	1	2	3	1	3	3	-	-
CO202	2.5	2	2.5	3	-	2.5	2.5	2	2.5	2.5	1	2.5	2.5	-	-

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EI7302 **ELECTRICAL MACHINES** **L T P C**
3 0 0 3

COURSE OBJECTIVES

1. To impart basic knowledge on different AC& DC Machines.
2. To introduce the concept of special machines and to motivate the students to solve simple/complex problems related to AC& DC machines.
3. Enable the student to choose machines for specific applications.
4. Make the students familiar with the testing and controlling of different machines.

UNIT I MAGNETIC CIRCUITS AND TRANSFORMERS 9

Introduction to Magnetic Circuits – flux linkage, inductance and energy – Transformer – Principle – Theory of ideal transformer – EMF equation – Construction details of shell and core type transformers – Tests on transformers – Equivalent circuit – Phasor diagram on load – Regulation and efficiency of a transformer.

UNIT II POLYPHASE INDUCTION MOTOR 9

Poly phase Induction motor: Construction and principle of operation – torque-slip characteristics – Efficiency – Application – starting methods – speed control of induction motor.

UNIT III DC MACHINES 9

Construction of D.C. Machines – DC Generator: Principle of operation – EMF equation – Characteristics – Introduction to Commutation process and Armature reaction. DC Motor: Principle of operation – Types – Torque equation – Characteristics – Starters – Speed control – Applications of DC machines.

UNIT IV SYNCHRONOUS MACHINES 9

Alternators: Principle of operation, Construction details – induced EMF equation – Vector Diagram – Voltage regulation – Synchronous motor: Principle of operation, Starting methods – Torque – Vcurve and Hunting.

UNIT V SPECIAL MACHINES 9

Single phase Induction motor – Torque Development – Capacitor start capacitor run motors – Shaded pole motor, Repulsion type motor, Universal motor, Hysterisis motor, Permanent magnet synchronous motor, Introduction to stepping motors – Switched reluctance motor.

TOTAL : 45 PERIODS

Course Outcomes (COs)

1. Remember the basic concepts and terms of electrical machines.
2. Apply the basic concepts associated with DC and AC electrical machines to test and control the machines.

Attested

3. Interpret the performance characteristics of machines.
4. Select suitable machines for carrying out interdisciplinary projects.
5. Apply the knowledge on various machines to choose appropriate machines for specific application useful for society.
6. Understand the working of new machines and to learn their concepts.

TEXT BOOKS:

1. Fitzgerald A.E, Kingsley C., Umans, S. and Umans S.D., "Electric Machinery", McGraw-Hill, Singapore, 2000.
2. Theraja, B.L., "A Text book of Electrical Technology", Vol.II, S.C Chand and Co., New Delhi, 2007.

REFERENCES:

1. Del Toro, V., "Electrical Engineering Fundamentals", Prentice Hall of India, New Delhi, 1995.
2. Cotton, H., "Advanced Electrical Technology", Sir Isaac Pitman and Sons Ltd., London, 1999.
3. NPTEL Video Lecture series on "Electrical Machines I" and "Electrical Machines II" by Dr. Krishna Vasudevan, IIT Madras.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO203.1	3	-	-	-	-	-	-	1	-	1	-	1	-	-	3
CO203.2	3	2	-	3	-	-	-	1	-	1	-	1	2	-	-
CO203.3	3	3	-	2	-	-	-	1	-	1	-	1	2	-	-
CO203.4	3	-	-	1	-	-	-	1	3	1	-	2	2	-	-
CO203.5	3	-	-	1	-	3	-	1	-	1	-	1	2	-	-
CO203.6	3	-	-	-	-	-	-	1	-	1	-	3	-	-	-
CO203	3	2.5	-	1.7	-	3	-	1	3	1	-	1.5	1.3	-	3

EI7303 ELECTRONICS FOR ANALOG SIGNAL PROCESSING I L T P C
4 0 0 4

COURSE OBJECTIVES

1. To introduce the students to the construction, operation, characteristics and applications of various semiconductor diodes and transistors.
2. To impart knowledge on different types of configurations and biasing circuits for BJT and FET.
3. To impart knowledge on single & multi-stage amplifiers, power amplifiers and oscillators.
4. To enable the students to analyze a given BJT / FET amplifier circuit for voltage gain, current gain, input impedance, output impedance and bandwidth.

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5. To enable the students to design transistor amplifiers and oscillators for a given set of specifications.

UNIT I SEMICONDUCTOR DIODES 12

PN junction diode: Forward and reverse characteristics, Applications in Rectifier, Switching, Clipper, Clamper and Protection circuits - Zener diode: Forward and reverse characteristics, Application as voltage regulator, Introduction to special diodes: Schottky diode, Varactor diode, Laser diode, Photodiode – UJT characteristics and application as relaxation oscillator, Thyristors: Characteristics and applications of SCR, DIAC and TRIAC.

UNIT II BJT AMPLIFIERS 12

BJT: NPN and PNP transistors, Characteristics of CE, CB and CC amplifier configurations, Biasing circuits, Operating point, Load line – Hybrid model, Two-port analysis, Mid-band analysis of BJT amplifier using h-parameters – High frequency model, Frequency response of BJT amplifier – Transistor switching circuits.

UNIT III FET AMPLIFIERS 12

FET: JFET and MOSFET, Characteristics of CS, CG and CD amplifier configurations – Biasing circuits for JFET and MOSFET, Operating point, Load line – Small signal model, Mid-band analysis of FET amplifier – High frequency model of FET, Frequency response of FET amplifiers - NMOS and CMOS inverter circuits.

UNIT IV MULTISTAGE AND FEEDBACK AMPLIFIERS 12

Multistage amplifier: Coupling schemes for cascading amplifier, General analysis of cascaded amplifier, Cascade and Bootstrap amplifiers. Feedback amplifier: Characteristics of feedback amplifier, AC analysis of feedback amplifiers: Voltage-Series, Voltage-Shunt, Current-Series and Current-Shunt amplifiers. Single and Double Tuned Amplifiers.

UNIT V OSCILLATORS AND POWER AMPLIFIERS 12

Oscillators: Classification, Condition for oscillation - Phase shift oscillators: RC phase shift and Wien Bridge oscillators - Resonant frequency oscillators: Hartley, Colpitts and crystal oscillators. Power amplifiers: Class A, Class B and Class AB amplifiers, Efficiency - Distortion in power amplifiers.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Ability to acquire basic knowledge on the working of various semi-conductor devices.
2. Ability to design and analyze PN junction diode, BJT and MOSFET devices under various conditions.
3. To develop competence in frequency response analysis of BJT and FET devices.

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4. To develop design competence in the area of multistage and feedback amplifiers.
5. To make the students understand the concept of various power amplifiers and tuned amplifiers.
6. Ability to design transistor amplifiers and oscillators for a given set of specifications.

TEXT BOOKS:

1. Jacob Millman, Christos C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", 3rd Edition, McGraw-Hill, 2011.
2. Donald A. Neaman, "Electronic Circuits Analysis and Design", 3rd Edition, Tata McGraw-Hill, 2008.

REFERENCES:

1. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2008.
2. Sedra and Smith, "Microelectronic circuits", 7th Edition, Oxford University Press, 2014.
3. Ben G. Streetman and Sanjay K. Banerjee, "Solid State Electronic Devices", 7th Edition, 2014.
4. Donald A. Neaman, "Semiconductor Physics and Devices Basic Principles", 3rd Edition, McGraw-Hill, 2003.
5. Salivahanan, S. and Suresh Kumar, N., "Electronic Devices and Circuits", 2nd edition, McGraw-Hill, 2011.
6. NPTEL video lectures on "Electronics for Analog Signal Processing I" by Prof. K.R.K. Rao, IITM.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO204.1	3	2	2	1	3	1	-	-	1	2	-	2	1	1	
CO204.2	3	2	2	2	3	1	-	-	1	2	-	2	1	2	1
CO204.3	3	2	2	1	2	1	-	-	1	2	-	2	-		
CO204.4	3	2	2	1	2	1	-	1	1	2	-	2	1	1	
CO204.5	3	2	2	-	2	1	-	-	1	1	-	2	1	1	
CO204.6	2	2	3	3	3	1	-	2	1	2	-	3	2	2	1
CO204	2.8	2	2.1	1.3	2.5	1	-	1.5	1	1.8	-	2.1	1.2	1.4	1

EI7304 FUNDAMENTALS OF PNEUMATICS AND HYDRAULICS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce the fundamentals of hydraulic and pneumatic systems and their applications.

2. To provide knowledge about the components involved in hydraulic and pneumatic systems.
3. To select the control strategy for hydraulic and pneumatic systems.
4. To gain basic safety precaution for hydraulic and pneumatic systems.
5. To understand the concept of interfacing these systems with PLC and various microcontrollers.

UNIT I FLUID POWER PRINCIPLES AND FUNDAMENTALS 9

ntroduction to fluid power – Advantages and Applications – Fluid power systems – Types of fluids–Properties of fluids – Basic of Hydraulics: Pascal's Law,Principles of flow ,work, Power and Torque. Properties of air – Perfect Gas Laws.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 9

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

UNIT III CONTROL OF HYDRAULIC SYSTEMS 9

Control Components: Direction control, flow control and pressure control valves – Types, Applications – Types of actuation – Pressure Switches – Fluid power ANSI Symbol. Industrial Hydraulic circuits – Regenerative, Double-Pump, sequence, Reciprocation, Synchronization, FailSafe, Speed Control – Hydrostatic Transmission.

UNIT IV PNEUMATIC SYSTEM 9

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

UNIT V ELECTRO HYDRALIC AND ELECTROPNEUMATIC CIRCUITS 9

Sequential circuits – design for simple applications using cascade method – Electro Pneumatic circuits – Microprocessor and PLC – Applications in Hydraulic and Pneumatics – Low cost Automation – Hydraulic and Pneumatic Power Packs – Installation, Fault finding and Maintenance.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The students will be able to

1. Acquire the knowledge on principles and applications of fluid power.
2. Acquire knowledge on working principle of pump, actuators, control elements of fluid power system
3. Understand the principles of accumulators and circuits.

Attested

4. Design circuit for typical applications like material handling, press, shaping, milling, grinding.
5. Design electro pneumatics and PLC Circuits.

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", 7th edition, Pearson education, 2014.
2. Srinivasan, R., "Hydraulic and Pneumatic Controls", 2nd edition, Vijay Nicole Imprints, 2008.

REFERENCES:

1. William W. Reaves, "Technology of Fluid Power", Delmer Publishers, 1997.
2. Petor Rohner, "Fluid power logic circuit Design", Macmillon Press Ltd, 1990.
3. Andrew Parr,"Hydraulics & Pneumatics", Jaico Publishing House, 2004.
4. Majumdar, "Oil Hydraulics: Principles and Maintenance", Tata McGraw Hill, 2004.
5. Majumdar, "Pneumatic system: Principles and Maintenance", Tata McGraw Hill, 2004.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO205.1	3	2	2	1	2	1	1	1	1	3	2	2	2	3	3
CO205.2	3	3	2	2	2	1	1	1	1	2	2	2	3	3	2
CO205.3	3	2	2	2	2	1	1	1	1	1	2	2	2	3	2
CO205.4	3	2	3	2	3	1	1	1	2	3	3	3	3	3	3
CO205.5	3	2	3	2	3	1	1	1	1	3	3	3	3	3	3
CO205	3	2.2	2.4	1.8	2.4	1	1	1	1.2	2.8	2.4	2.4	2.6	3	2.6

EI7305 INSTRUMENT TRANSDUCERS L T P C

4 0 0 4

COURSE OBJECTIVES

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

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 12

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 12

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 12

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 CAPACITANC TRANSDUCERS 12

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 12

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

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Ability to apply the Mathematical knowledge, science and Engineering fundamentals
2. To solve the problems pertaining to measurement applications and to perform error/ uncertainty analysis.
3. Ability to understand transduction principles and select suitable transducer for specific application.
4. Ability to determine the static and dynamic characteristics of various transducers.
5. Ability to design signal conditioning circuits for resistive, inductive and capacitive transducers.

6. Ability to select and apply application specific transducer for engineering problems.

TEXT BOOKS:

1. Doebelin E.O. and Manik D.N., "Measurement Systems", 6th Edition, Tata McGraw-Hill Education Pvt. Ltd., 2011.
2. Renganathan, S.," Transducer Engineering", Allied Publishers, New Delhi, 2003.

REFERENCES:

1. Neubert, H.K.P., "Instrument Transducers – An Introduction to their Performance and Design", Oxford University Press, Cambridge, 2003.
2. Albert, D. Helfrick and Cooper, W. D., "Modern Electronic Instrumentation and Measurement Techniques", PHI Learning Pvt. Ltd., 2011.
3. Murthy, D.V.S., "Transducers and Instrumentation", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
4. John P. Bentley, "Principles of Measurement Systems", 4th Edition, Pearson Education, 2004.
5. Bolton, W., "Engineering Science", Elsevier Newnes, 5th Edition, 2006.
6. Patranabis, D., "Sensors and Transducers", 2nd Edition, Prentice Hall of India, 2010.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO206.1	**3**	**3**	**2**	**3**	**1**	**1**	-	-	-	-	-	**1**	**1**	**1**	-
CO206.2	**2**	**1**	**1**	**1**	**1**	**2**	-	-	-	-	-	**1**	**2**	**2**	-
CO206.3	**3**	**3**	**3**	**2**	**1**	**1**	-	-	-	-	**1**	**1**	-	**3**	-
CO206.4	**3**	**2**	**3**	**2**	**3**	**2**	-	-	-	-	**1**	**1**	**3**	**2**	-
CO206.5	**1**	**2**	**2**	**1**	**2**	-	-	-	-	-	**1**	**1**	**2**	**1**	-
CO206.6	**2**	**2**	**3**	**3**	**2**	**1**	1	1	-	1	**1**	**1**	**2**	**3**	-
CO206	2.3	2.16	2.3	2	1.6	1.4	1	1	-	1	1	1	2	2	-

EI7311 ELECTRICAL MACHINES LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES

1. To obtain the no load characteristics of D.C and A.C machines.
2. To obtain the load characteristics of D.C and A.C machines.
3. To find out regulation characteristics of A.C. generator and Transformer.
4. To obtain the speed characteristics of D.C motor.
5. To obtain the control of special machines like stepper motor.

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of self excited DC generator.

2. Open circuit and load characteristics of separately excited DC generator.
3. Speed control of separately excited DC shunt motor.
4. Load test on DC shunt and series motors.
5. Regulation of three- phase alternator.
6. Predetermination of efficiency and regulation of single phase transformer.
7. Load test on single phase transformer.
8. No load and Blocked rotor test on three phase induction motor.
9. Load test on single phase induction motor.
10. V curves of synchronous motor.
11. Study of AC drives.
12. Study of DC drives.

TOTAL : 60 PERIOD

COURSE OUTCOMES

1. Ability to obtain the dynamic characteristics of electrical machines.
2. Ability to understand the concepts of no-load and full-load tests of DC and AC machines.
3. Ability to perform the efficiency and load test on single-phase transformer.
4. Ability to control the speed of the DC motor.
5. Acquire knowledge of AC drives and DC drives.
6. Ability to prepare the reports of the experiments carried out in the laboratory.
7. Ability to carry out the experiments in batches to motivate the team work.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO207.1	3	3	-	-	-	-	-	3	-	3	3	-	1	2	-
CO207.2	3	3	-	-	-	-	-	3	-	3	3	-	1	2	-
CO207.3	3	3	2	1	-	-	-	3	-	3	3	-	1	2	-
CO207.4	3	3	3	3	-	-	-	3	-	3	3	-	1	2	-
CO207.5	3	2	2	-	3	-	-	3	-	3	3	1	1	2	3
CO207.6	2	1	3	-	-	-	-	3	-	3	3	-	1	2	-
CO207.7	2	1	-	-	-	-	-	3	3	3	3	-	1	2	-
CO207	2.7	2.2	2.4	2	3	-	-	3	3	3	3	1	1	2	3

EI7312 ELECTRONICS FOR ANALOG SIGNAL PROCESSING LABORATORY

L T P C
0 0 4 2

COURSE OBJECTIVES

1. To facilitate the students to study the characteristics of various semiconductor devices.
2. To provide practical knowledge on the analysis of rectifiers, regulators, amplifiers and oscillators.

Attested

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3. To enable the students to design rectifiers, regulators, amplifiers and oscillators for a given set of specifications.
4. To impart hands-on training to the students on e-CAD tools used for designing electronic circuits.

LIST OF EXPERIMENTS

1. Study of CRO, DSO, Function Generator, Power Supply and Multi-meter.
2. (a) PN junction diode characteristics and application as a rectifier.
   (b) Zener diode characteristics and application as a regulator.
3. Characteristics of BJT amplifier in CE configuration and determination of h-parameters.
4. Characteristics of JFET amplifier in CS configuration and determination of amplification factor.
5. Characteristics of UJT and application as a relaxation oscillator.
6. Characteristics of SCR and application as a controlled rectifier.
7. Design of Voltage divider bias for BJT and FET circuits for a given operating point.
8. Determination of the Frequency response of CE and CS amplifiers.
9. Design of a cascaded CE amplifier.
10. Design of Wien Bridge oscillator and Colpitts oscillator circuits.
11. Design of series voltage regulator.
12. Simulation of at least four of the above experiments using e-CAD tools.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs):

1. Gain knowledge on the proper usage of various electronic equipment and simulation tools for design and analysis of electronic circuits.
2. Get hands-on experience in studying the characteristics of semiconductor devices.
3. Ability to analyze various electronic circuits such as diode rectifiers, controlled rectifiers, voltage regulators, transistor amplifiers and oscillators.
4. Ability to present the results in oral form as well as in written form as a report.
5. Ability to interpret the results and draw meaningful conclusions.
6. Ability to work as a member of a team while carrying out experiments.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO208.1	3	3	3	1	3	1	-	3	2	3	3	2	1	-	-
CO208.2	3	3	3	1	3	1	-	3	2	3	3	2	-	-	1
CO208.3	3	-	3	3	2	1	-	3	3	3	3	2	3	2	2
CO208.4	3	-	3	3	2	1	-	3	2	3	3	2	2	3	-
CO208.5	3	-	2	1	2	1	-	3	2	3	3	2	3	-	-
CO208.6	2	-	-	-	3	1	-	3	3	3	3	3	-	-	-
CO208	2.8	3	2.8	1.8	2.5	1	-	3	2.3	3	3	2.1	2.2	2.5	1.5

MA7356 PROBABILITY AND RANDOM PROCESSES L T P C
(Branch specific course) 4 0 0 4

OBJECTIVES:

1. To provide the necessary basic concepts in probability and random processes and apply them in random signals, linear systems etc. in communications engineering.
2. The students will have an exposure of various distributions.

UNIT I RANDOM VARIABLES 12

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma, Weibull and Normal distributions - Functions of a random variable.

UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III RANDOM PROCESSES 12

Classification – Stationary process – Markov process - Poisson process – Random telegraph process.

UNIT IV CORRELATION AND SPECTRAL DENSITIES 12

Auto-correlation functions – Cross-correlation functions – Properties – Power spectral density – Cross-spectral density – Properties.

UNIT V LINEAR SYSTEMS WITH RANDOM INPUTS 12

Linear time invariant system – System transfer function – Linear systems with random inputs – Autocorrelation and Cross-correlation functions of input and output - White noise.

TOTAL : 60 PERIODS

COURSE OUTCOMES(CO):

1. Students will be able characterize probability models using probability mass (density) functions & cumulative distribution functions
2. Students will be able to describe a random process in terms of its mean and correlation functions.
3. Students will demonstrate knowledge in special processes like Poisson, Renewal processes.

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TEXTBOOKS:

1. Ibe, O.C. "Fundamentals of Applied Probability and Random Processes", Elsevier, U.P., 1st Indian Reprint, 2007.
2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles", Tata McGraw Hill, New Delhi, 4th Edition, 2002.

REFERENCES:

1. Yates, R.D. and Goodman, D.J., "Probability and Stochastic Processes", John Wiley and Sons, 2nd Edition, 2005.
2. Miller, S. L. and Childers, D. G., "Probability and Random Processes with Applications to Signal Processing and Communications", Academic Press, 2004.
3. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill, New Delhi, 9th Reprint, 2010.

EI7401 DIGITAL PRINCIPLES AND APPLICATIONS LT P C
3 0 0 3

COURSE OBJECTIVES

1. To study various number systems, Boolean expressions and simplifications.
2. To study, analyze and design of the combinational logic circuits for arithmetic operations.
3. To study, analyze and design of sequential circuits, registers and counters.
4. To study, analyze and design asynchronous sequential circuits and to know the functions of ASM charts.
5. To learn memory components, PLA, PAL and the basic of HDL.

UNIT I BOOLEAN ALGEBRA AND LOGIC GATES 9

Review of number systems – Arithmetic operations in binary number system – Binary codes – Boolean algebra and rules – Boolean functions: Simplifications: standard / canonical form of SOP and POS, Simplification using Karnaugh Map and Tabulation methods – Basic logic gates – Universal gates.

UNIT II COMBINATIONAL LOGIC 9

Combinational circuits – Analysis and design procedures – Circuits for arithmetic operations: Full adder, Carry look-ahead adder, binary adder, adder-subtractor, comparators – Code conversion – Decoders and Encoders – Multiplexers and De-multiplexers.

Attested

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UNIT III SYNCHRONOUS SEQUENTIAL LOGIC 9

Sequential circuits – Flip flops: Triggering, types, conversions, excitation tables – Analysis and design procedures – State reduction and state assignment – Shift registers – Counters: MOD counters, up-down counter, ring counters – Sequence detectors.

UNIT IV ASYNCHRONOUS SEQUENTIAL LOGIC 9

Analysis and design of asynchronous sequential circuits – Reduction of state and flow tables – Race-free state assignment – Arithmetic State Machines: Introduction, components, features, examples.

UNIT V MEMORY AND PROGRAMMABLE LOGIC DEVICES 9

RAM and ROM types – Memory decoding - Error detection and correction - Programmable logic devices: Programmable Array Logic – Programmable Logic Array – Types of sequential programmable devices – Hardware Description Language: Introduction - HDL for combinational logic circuits - HDL for Sequential logic circuits.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. 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.
2. An ability to choose suitable AC and DC bridge for measuring R, L, C and frequency for the required specifications
3. An ability to apply knowledge of electronic instrumentation for measurement of electrical quantities.
4. Able to apply the principles and practices for instrument design and development to real world problems.
5. Ability to analyze and store the signals using various display and recording devices.
6. Ability to suggest the kind of instrument appropriate for typical measurements.

TEXT BOOKS:

1. Morris Mano, M. and Michael D. Ciletti, “Digital Design with an Introduction to the Verilog HDL”, 5th Edition, Prentice Hall, 2013.
2. Donald P Leach, Albert Paul Malvino and Goutam Saha, “Digital Principles and Applications”, 8th Edition, McGraw-Hill, 2014.

REFERENCES:

1. Thomas L. Floyd, "Digital Fundamentals", 11th Edition, Prentice Hall, 2015.
2. Anand Kumar, A., "Switching Theory and Logic Design", 2nd Edition, PHI, 2014.
3. John F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 2008.
4. Arijith Saha and Nilotpal Manna, "Digital Principles and Logic Design", Laxmi Publication, 2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO210.1	2	2	2	2	-	2	3	3	3	2	1	2	-	2	-
CO210.2	3	2	3	3	-	3	2	2	2	3	1	3	-	3	-
CO210.3	3	2	3	3	-	3	2	2	2	3	1	3	-	3	-
CO210.4	3	2	3	3	-	3	2	2	2	3	1	3	-	3	-
CO210.5	3	2	3	3	-	3	2	2	2	3	1	3	-	3	-
CO210.6	2	2	2	2	-	2	3	3	3	2	1	2	-	2	-
CO210	2.6	2	2.6	2.6	-	2.6	2.3	2.3	2.3	2.6	1	2.6	-	2.6	-

EI7402 ELECTRONICS FOR ANALOG SIGNAL PROCESSING II

L T P C
4 0 0 4

COURSE OBJECTIVES

1. To introduce the basics of operational amplifiers, their characteristics and their configurations.
2. To impart knowledge about the concepts and applications of timer, PLL, ADC and DAC.
3. To enable the students to analyze the given integrated circuit and evaluate the output.
4. To enable the students to design signal conditioning circuits using operational amplifiers.
5. To enable the students to design multi-vibrator circuits using OPAMP / Timer for switching applications.

UNIT I OPERATIONAL AMPLIFIERS **12**

Differential amplifier: BJT and FET configurations, Differential mode and common mode equivalent circuits, Single-ended and Double-ended output, CMRR – OPAMP: Internal blocks, Ideal characteristics, DC and AC characteristics of non-ideal OPAMP, Frequency compensation techniques, Methods of improving Slew rate and CMRR – Inverting and Non-inverting OPAMP configurations, Summing and Difference amplifiers.

Attested

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UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIER 12

Differentiator and Integrator: ideal and practical circuits, V to I and I to V converters - Instrumentation amplifier circuit analysis, Instrumentation amplifier IC – Active Filters: Low pass, High pass, Band pass and Band reject filters – Comparator, Schmitt trigger, Multi-vibrators, Triangular wave generator, Sine wave generator, Function generator - Clipper and Clamper – Log and Antilog amplifiers.

UNIT III TIMER AND PHASE LOCKED LOOP 12

Timer IC: Internal blocks – Multi-vibrator circuits and their applications. VCO: Functional block diagram, Operation, V-F conversion factor, Application – Phase detector: Analog and Digital, Conversion gain – PLL IC: Internal block diagram, Operation, Capture range, Lock range, Applications: Generation of FM signal, Demodulation of AM, FM and FSK signals.

UNIT IV ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 12

Analog switches, Sample and hold IC, DAC principle, Resolution, Range – Types: Weighted R, R-2R and Inverted R-2R, DAC ICs – ADC: Principle, Types: Flash, Counting, Single slope, Dual slope, Successive approximation – ADC ICs.

UNIT V SPECIAL FUNCTION IC'S 12

Analog multiplier: Single, double and four quadrant multipliers - Operational trans-conductance amplifier, Power amplifier: Audio and video amplifiers – Linear voltage regulator: Internal blocks, low and high voltage regulator operation, Current protection – Switched regulator, Buck, Boost & Buck/boost regulators – Switched capacitor filter, Isolation amplifier, Opto-coupler.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Ability to acquire knowledge on the fundamentals of operational amplifiers and their configurations.
2. Ability to acquire knowledge on linear and non-linear applications of operational amplifiers
3. To enable the students to design signal conditioning circuits using operational amplifiers.
4. To impart knowledge about the concept and applications of 555 timer IC and PLL.
5. Ability to recommend the appropriate A/D and D/A converters for signal processing applications.
6. To make the students understand the concept of analog multipliers, Audio and video amplifiers and voltage regulators.

TEXT BOOKS:

1. Ramakant Gayakwad, "Op-amps and Linear Integrated Circuits", 4th Edition, Prentice Hall, 2000.
2. Robert, F., Coughlin, Frederick F., Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 5th Edition, Prentice Hall, 1998.

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REFERENCES:

1. Sergio Franco, "Design with Operational Amplifiers and Linear Integrated Circuits", 3rd Edition, Tata McGraw-Hill, 2002.
2. Paul R. Gray, "Analysis and Design of Analog Integrated Circuits", 5th Edition, Wiley, 2010.
3. Roy Choudhry, D. and Shail B. Jain, "Linear Integrated Circuits", 2nd Edition, New Age International, 2003.
4. NPTEL video lectures on "Electronics for Analog Signal Processing II" by Prof. K.R.K. Rao, IITM.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO211.1	3	1	1	1	3	1	-	-	1	2	-	2	1	2	2
CO211.2	3	2	2	2	3	1	-	-	1	2	-	2	2	3	1
CO211.3	3	3	3	3	3	1	-	2	1	3	-	3	3	3	1
CO211.4	3	2	2	1	-	1	-	-	1	2	-	2	1	1	-
CO211.5	3	2	2	2	-	1	-	1	1	3	-	2	1	2	1
CO211.6	2	2	2	1	1	1	-	-	1	2	-	2	1	2	1
CO211	2.8	2	2	1.6	1.6	1	-	1.5	1	2.3	-	2.1	1.5	2.1	1.2

EI7403 FUNDAMENTALS OF THERMODYNAMICS AND FLUID MECHANICS

L T P C
3 0 0 3

COURSE OBJECTIVES

1. To understand the basic laws of thermodynamics.
2. To make the students to familiarize with the concepts, laws and methodologies
3. for the analysis of gas turbines and compressors.
4. To understand the basic concepts of fluid mechanics.
5. To explore the working principle of different types of pumps and Hydraulic turbines.

UNIT I BASIC CONCEPTS AND LAWS OF THERMODYNAMICS 9

Thermodynamic system and surroundings – properties of system – STATE AND EQUILIBRIUM Forms of energy – Quasi static process – Zeroth law of thermodynamics – Work and heat transfer –Path and point functions – First law of thermodynamics applied to open systems – SFEE equation and its applications.Second law of thermodynamics applied to Heat engines, Refrigerators& Heat pumps. Carnot's theorem and clausius inequality – Concept of entropy applied to reversible and irreversible processes – Third law of thermodynamics.

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UNIT II INTRODUCTION TO APPLICATIONS OF THERMODYNAMICS 9

Air standard cycles – Thermodynamics assumption – Otto cycle, diesel cycle and Brayton cycle standard efficiency, mean effective pressure and power Air compressors: classification, single and multistage compressors, inter-cooler in compression process.

Refrigerators: classification, vapour compression and absorptions systems, Eco-friendly refrigerants.

Heat Transfer: introduction to modes of heat transfer with examples.

UNIT III BASIC CONCEPT OF FLUID MECHANICS & FLOW OF FLUIDS 9

Fluid: Properties and types.

Pressure: laws of pressure, types of pressure, pressure measurement using manometers and mechanical gauges. Viscosity: Kinematic and dynamic viscosity.

Fluid kinematics and dynamics – Types of fluid flow – velocity – rate equation of continuity – energy of a liquid in motion – head of a liquid – Bernoulli's theorem

UNIT IV DIMENSIONAL AND MODEL ANALYSIS 9

Dimension – need for dimensional analysis, Rayleigh's and Buckingham's method applied to flow problems, limitation of dimensional analysis.

Model analysis – similitude, dimensionless numbers and their significance, similarity laws, model studies, limitation of scale models.

UNIT V HYDRAULIC MACHINES 9

Introduction and classification of hydraulic machines. Reciprocating pump: constructional details,

working principle, co-efficient of discharge, slip, power required.

Centrifugal pump: classification and working principle, specific speed.

Turbines: classification, working principle of a Pelton wheel turbine.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand and apply the basic laws of thermodynamics and fluid mechanics for different applications.
2. Ability to use the basic concepts and methodologies for the analysis of gas turbine and compressors.
3. Ability to understand the need of dimensional and model analysis.
4. Ability to understand the working principle of different types of pumps and hydraulic turbines.
5. Acquire knowledge on the various types of fluid machines.

TEXT BOOKS:

1. Nag, P.K., "Engineering Thermodynamics", Tata McGraw-Hill Co. Ltd., 2007.
2. Chattopadhyay, P., " Engineering Thermodynamics", Oxford University Press, New Delhi, 2010.
3. Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics" Prentice-Hall India, 2005.
4. Bansal. R.K., "Fluid Mechanics and Hydraulics Machines", Lakshmi Publications Pvt. Ltd., New Delhi, 9th Edition, 2015.

REFERENCES:

1. Reynold, "Thermodynamics", Int. Student Edition, McGraw-Hill Co. Ltd., 1990.
2. Ramalingam, K.K., "Thermodynamics", Sci-Tech Publications, 2006.
3. Holman, J.P, " Heat Transfer", 3rd Edition, McGraw-Hill, 2007.
4. Shames, I.H., "Mechanics of Fluids", Kogakusha, Tokyo, 1998.
5. Kumar, K.L., "Fluid Mechanics", Eurasia Publishers, 1990.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO212.1	3	2	3	2	2	-	-	-	-	-	-	1	1	1	1
CO212.2	3	2	3	2	2	-	-	-	-	-	-	1	1	1	1
CO212.3	3	2	3	2	2	2	-	-	-	-	-	1	1	1	1
CO212.4	3	2	3	2	2	2	-	-	-	-	-	1	1	1	1
CO212.5	3	2	3	2	2	2	-	-	-	-	1	1	1	1	1
CO212	3	2	3	2	2	2	-	-	-	-	1	1	1	1	1

EI7404 INDUSTRIAL INSTRUMENTATION I

L T P C
3 0 0 3

COURSE OBJECTIVES

1. To make students understand the physical principles and operation of industrial instruments for force, torque, speed, acceleration, vibration, density, viscosity, humidity, moisture, temperature, and pressure.
2. To make students understand the significance, limitations and applications of each industrial instruments.
3. To make students gain knowledge in solving numerical problems related to industrial instruments.
4. To make students design signal conditioning and compensation circuits for industrial instruments
5. To make students capable to select a industrial instruments for a particular application.

UNIT I UNIT I MEASUREMENT OF FORCE, TORQUE AND SPEED 8

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

UNIT II MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY 8

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

UNIT III MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE 8

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

UNIT IV TEMPERATURE MEASUREMENT 12

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

UNIT V PRESSURE MEASUREMENT 9

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

Attested

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the construction and working of instruments used for measurement of force, torque, speed, acceleration, vibration, density, viscosity, humidity, moisture, temperature and pressure.
2. Ability to analyze and select suitable sensor for the given industrial application
3. Understand the concept of calibration of instruments
4. Ability to design signal conditioning circuits and compensation schemes for measuring instruments.
5. Ability to apply the acquired knowledge in instrumentation design, installation and commissioning of measuring instruments

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. 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, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2010.
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.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO213.1	3	2	2	2	2	2	1	1	1	1	1	1	1	1	1
CO213.2	2	3	2	2	2	2	1	1	1	1	1	1	2	2	1
CO213.3	3	3	2	2	3	2	1	1	1	1	1	1	1	3	1
CO213.4	2	2	3	3	2	2	1	1	1	1	1	1	3	2	1
CO213.5	2	2	3	3	2	2	1	1	1	1	1	1	1	1	1
CO213	2.4	2.4	2.4	2.4	2.2	2	1	1	1	1	1	1	1.6	1.8	1

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EI7405 PRINICIPLES OF COMMUNICATION ENGINEERING LT P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce the students to the principles of analog and digital communication.
2. To impart knowledge on the modulation and demodulation techniques, pulse communication systems and digital data transmission techniques.
3. To facilitate the students in analyzing the performance of transmitters and receivers.
4. To familiarize the students with the principles of multi-user communication systems.

UNIT I AMPLITUDE AND FREQUENCY MODULATION 9

Amplitude modulation: Principle, Spectrum, Modulation index, DSB-C, DSB-SC and SSB generation, transmission and reception, Super heterodyne receiver, Noise in AM receiver. Frequency modulation: Principle, Spectrum, Modulation index, FM generation, transmission and reception, Noise in FM systems, Pre-emphasis and De-emphasis.

UNIT II PULSE AND SPREAD SPECTRUM MODULATION 9

Pulse Modulation: Sampling theorem, Principles of PAM, PPM, PWM, PCM, DPCM, DM and ADM, Quantization noise in PCM. Spread spectrum modulation: Pseudo noise sequence, Direct sequenced spread spectrum, Frequency hopping spread spectrum.

UNIT III BASEBAND PULSE TRANSMISSION 9

Baseband coding techniques: Polar / Bipolar, RZ/NRZ and Manchester - M-ary PAM transmission, Baseband receiver: Error probability, Optimum and matched filter techniques, Optimum linear receiver, Probability of error.

UNIT IV PASSBAND DIGITAL TRANSMISSION 9

Digital modulation systems: Pass band transmission model, Asynchronous transmission, ASK, BFSK, BPSK and QPSK - Coherent reception - Signal space representation - Probability of error - Comparison of data transmission systems.

UNIT V COMMUNICATION SYSTEMS 9

Concept of multiplexing: FDM and TDM. Multiple Access: FDMA, TDMA and CDMA. Telephone switching - Mobile telephonic communication - Satellite communication - Radar system - Microwave communication.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs):

1. Understand the principles of modulation and demodulation techniques.

2. Classify the types of analog, pulse and digital modulation schemes.
3. Explain the baseband coding techniques.
4. Demonstrate the different types of multiplexing schemes used in communication systems.
5. Analyze various band-pass signaling schemes and compare their performance.
6. Describe the basic components of different communication systems.

TEXT BOOKS:

1. Simon Haykin, "Communication Systems", 4th Edition, Wiley India, 2010.
2. Herbert Taub, Donald Schilling and Goutam Saha, "Principles of Communication Systems", 3rd Edition, McGraw-Hill, 2011.

REFERENCES:

1. Dennis Roddy and John Coolen, "Electronic Communications", 4th Edition, Pearson Education,2008.
2. B.P. Lathi and Zhi Ding, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2010.
3. John G. Proakis and Masoud Salehi, "Digital Communication", 4th Edition, McGraw-Hill, 2008.
4. Singh, R.P. and Sapre, S.D., "Analog and Digital Communication Systems", McGraw-Hill Publishing Company Ltd., 2007.
5. Kennedy, G., "Electronic Communication Systems", McGraw-Hill, 4thEdition, 35th reprint, 2008.
6. Bruce Carlson, A., and Paul B. Crilly "Communication Systems", 5th Edition, Tata McGraw-Hill, 2010.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO214.1	3	2	1	1	1	2	-	-	-	2	2	-	1	1	-
CO214.2	3	2	1	1	1	2	-	-	-	2	2	-	2	2	-
CO214.3	3	1	1	1	1	2	-	-	-	1	1	-	2	1	-
CO214.4	3	2	2	1	1	2	-	-	-	1	2	-	2	1	-
CO214.5	3	3	3	2	2	1	-	-	-	1	1	-	1	1	-
CO214.6	3	2	2	1	1	2	-	-	-	1	2	-	2	2	-
CO214	3	2	1.6	1.1	1.1	1.8	-	-	-	1.3	1.6	-	1.6	1.3	-

EI7411 DIGITAL SYSTEM DESIGN LABORATORY LT P C
0 0 4 2

COURSE OBJECTIVES

1. To design, implement and verify digital combinational circuits such as adders, decoders, encoders, magnitude comparators and multiplexers.
2. To design and analyze sequential logic circuits such as counters and shift registers.
3. To understand the principles of HDL and verify the operation of logic circuits through simulation.

LIST OF EXPERIMENTS

1. (a) Verification of logic gates – NAND, NOR, AND, OR, XOR, XNOR and NOT.
   (b) Study of flip-flops – SR, JK, D and T flip-flops.
2. Realization of Boolean expressions using gates.
3. Design of code converter, Encoder and Decoder using gates.
4. Implementation of Combinational logic circuits using MUX and Decoder ICs.
5. Design of Adders using gates and parallel adder using IC.
6. Implementation of Asynchronous counters with 7-segment display.
7. Implementation of Synchronous counters with 7-segment display.
8. Implementation of universal shift registers using flip-flops and IC.
9. Simulation of combinational logic circuits using HDL.
10. Simulation of sequential logic circuits using HDL.
11. Porting of combinational and sequential logic circuits into FPGA/CPLD.
12. Design of combinational / sequential logic circuit for instrumentation application such as Alarm / Interlock.

TOTAL: 60 PERIODS

COURSE OUTCOMES (COs)

1. Apply Boolean theorems for simplifying logical expressions.
2. Design and analyze the combinational logic circuits and sequential logic circuits.
3. Employ the logic circuits (combinational / sequential) for instrumentation applications.
4. Interpret the results of analysis and draw meaningful conclusions.
5. Present the results in oral form as well as in written form as a report.
6. Understand the principles of HDL and verify the operation of logic circuits through simulation.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO215.1	3	3	3	2	2	-	-	3	3	3	3	1	1	2	-
CO215.2	3	3	3	3	3	2	-	3	3	3	3	3	2	3	-
CO215.3	3	3	3	3	3	3	-	3	3	3	3	3	2	3	-
CO215.4	3	3	3	3	3	3	-	3	3	3	3	2	1	2	-
CO215.5	3	3	3	3	3	1	-	3	3	3	3	1	1	2	-
CO215.6	3	3	3	3	3	3	-	3	3	3	3	2	2	3	-
CO215	3	3	3	2.8	2.8	2.4	-	3	3	3	3	2	1.5	2.5	-

EI7412 SENSORS AND SIGNAL CONDITIONING CIRCUITS LABORATORY

L T P C
0 0 4 2

COURSE OBJECTIVES

1. To make the students aware of basic concepts of measurement and operation of different types of transducers.
2. To make the students conscious about static and dynamic characteristics of different types of transducer.

LIST OF EXPERIMENTS

1. Static and Dynamic characteristics of Thermocouple (J,K,E) with and without thermowell.
2. Static and Dynamic characteristics of RTD and Thermistor.
3. Characteristics of linear displacement transducers (LVDT and Hall Effect sensor).
4. Characteristics of angular displacement transducers (Synchros and Capacitive transducer).
5. Sensitivity analysis of strain gauge bridges (quarter, half and full).
6. a. Static characteristic of flapper-nozzle system.
b. Loading effect on resistive potentiometer.
7. Characteristic of seismic type accelerometer.
8. Measurement of inductance (Anderson), capacitance (Schering) and resistance (Kelvin double) using bridges.
9. a. Design of V/I and I/V converters.
b. Design and testing of Instrumentation amplifier.
10. Design of cold junction compensation for Thermocouples and lead wire compensations for RTD.
11. Design of signal conditioning circuits for high output impendence sensor (pH).
12. PC Based Data Acquisition system.

TOTAL: 60 PERIODS

COURSE OUTCOMES(COs)

1. Ability to understand the concept of LabVIEW based Data Acquisition Systems.
2. Ability to perform the measurement error, uncertainty and sensitivity analysis.
3. Ability to evaluate the static and dynamic characteristics of measuring instruments.
4. Acquire knowledge of importance in calibration for special transducers.
5. Ability to interface and analysis of different signal conditioning units.
6. Ability to design and experimentation on various measuring instruments.
7. Ability to work as a member of a team while carrying out experiments.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO216.1	3	2		2	3	-	-	3	-	3	3		1	2	-
CO216.2	3	3	3		2	-	-	3	-	3	3	1	1	2	-
CO216.3	2	3	1	3	2	-	-	3	-	3	3	1	1	2	-
CO216.4	3	-	-	-	2	-	-	3	-	3	3	1	1	2	-
CO216.5	3	3	2		-	-	-	3	-	3	3	-	1	2	3
CO216.6	2	-	3	3	-	-	-	3	-	3	3	-	1	2	-
CO216.7	2	-	-	-	-	-	-	3	3	3	3	-	1	2	-
CO216	2.5	2.7	2.2	2.6	2.2	-	-	3	3	3	3	1	1	2	3

EI7501 CONTROL SYSTEMS **LT P C**
4 0 0 4

COURSE OBJECTIVES

1. To make the students familiarize about various representations of systems.
2. To develop linear models mainly state variable model and Transfer function model from Non Linear systems.
3. To make the students analyze linear systems in time domain and frequency domain.
4. To train the students to design compensator for system(s) using time and frequency domain techniques.

UNIT I MODELING OF LINEAR TIME INVARIANT SYSTEM (LTIV) 12

Control system: Open loop and Closed loop – Feedback control system characteristics – First principle modeling: Mechanical, Electrical and Hydraulic systems – Transfer function representations: Block diagram and Signal flow graph.

UNIT II STATE SPACE MODEL OF LTIV AND LTV SYSTEMS 12

State variable formulation – Non uniqueness of state space model – State transition matrix –Free and forced responses for Time Invariant and Time Varying Systems – Controllability – Observability.

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UNIT III TIME DOMAIN AND STABILITY ANALYSIS **12**

Standard test inputs – Time responses – Time domain specifications – Stability analysis: Concept of stability – Routh Hurwitz stability criterion – Root locus: Construction and Interpretation.

UNIT IV FREQUENCY DOMAIN ANALYSIS **12**

Frequency response plots: Bode plot, Polar plot and Nyquist plot – Frequency domain specifications: Resonance peak, Resonant frequency and Bandwidth – Stability Analysis: Gain margin and Phase margin.

UNIT V DESIGN OF FEED BACK CONTROL SYSTEM **12**

Design specifications – Lead, Lag and Lag-lead compensators using Root locus and Bode plot techniques – Introduction to Non-linear system.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Ability to develop various representations of system based on the knowledge of Mathematics, Science and Engineering fundamentals.
2. Ability to do time domain and frequency domain analysis of various models of linear system.
3. Ability to come out with solution for complex control problem.
4. Ability to interpret characteristics of the system to develop mathematical model.
5. Ability to design appropriate controller for the given specifications.

TEXT BOOKS:

1. Benjamin C. Kuo, "Automatic Control Systems", 7th Edition PHI Learning Private Ltd., 2010.
1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2010.

REFERENCES:

1. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Education Pearson, 3rd Impression, 2009.
2. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2009.
3. Katsuhiko Ogata, "Modern Control Engineering", PHI Learning Private Ltd, 5th Edition, 2010.
4. NPTEL Video Lecture Notes on "Control Engineering" by Prof. S. D. Agashe, IIT Bombay.

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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO301.1	3	2	2	2	2	1	-	1	1	2	1	3	-	-	3
CO301.2	2	3	2	2	2	1	-	1	1	2	1	3	-	-	3
CO301.3	2	2	3	2	2	1	-	1	1	2	1	3	-	-	3
CO301.4	2	2	2	3	2	1	-	1	1	2	1	3	-	-	3
CO301.5	2	2	3	2	2	1	-	1	1	2	1	3	-	-	3
CO301	2.2	2.2	2.4	2.2	2	1	-	1	1	2	1	3	-	-	3

EI7502 FUNDAMENTALS OF DATA STRUCTURES AND ALGORITHMS **L T P C**
3 0 0 3

COURSE OBJECTIVES

1. To provide an introduction to computer algorithms and data structures, with an emphasis on foundational material.
2. To have a good understanding of the fundamental data structures used in computer science
3. To have a good understanding of how several fundamental algorithms work, particularly those concerned with sorting, searching and graph manipulation
4. To analyze the space and time efficiency of most algorithms
5. To design new algorithms or modify existing ones for new applications and reason about the efficiency of the result

UNIT I ARRAYS AND LINKED LISTS **9**

Linear arrays: Representation of linear arrays, insertion and deletion in linear arrays - Multidimensional arrays: Representation of n-dimensional arrays in memory – Linked list: Representation in memory, List traversal, Insertions and deletions – Sorted linked list: Searching, insertion and deletion – Introduction to doubly linked list, circular and header linked lists.

UNIT II STACKS AND QUEUES **9**

Stack: Representation of stack with arrays and linked lists, Simple applications, Recursive functions and its implementations – Queues: Representation of queue with arrays and linked lists, Implementation of Circular queue and Priority queue, Representation of double ended queues.

UNIT III TREES **9**

Binary Trees: Types of binary trees, Representation of binary trees in memory, Recursive and nonrecursive traversals – Binary Search Tree: Search, insertion and deletion – Representation of AVL tree – Heap Tree: Search, insertion and deletion – Construction of a minimum weighted

path length tree – Conversion of general tree to binary tree representation – Thread representation in binary trees.

UNIT IV GRAPHS **9**

Definitions – Representation of graph with adjacency matrix and linked list – Path matrix: Shortest path algorithms – Warshall's algorithm, Dijkstra's algorithm – Minimum spanning trees: Prim's algorithm and Kruskal's algorithm – Graph traversal: Breadth first search tree and depth first search and tree – Topological sorting.

UNIT V SEARCHING AND SORTING **9**

Search: Binary search, Interpolation search – Hashing: Hash function, collision, rehashing, extendible hashing – Collision resolution: Open addressing, Separate chaining – Sorting: Selection, Bubble, Insertion, Merge, Quick and Heap sorting.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Weiss, M. A., "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2011.
2. Lipschutz, S., "Data Structures with C (Schaum's outline series)", McGraw-Hill, 2011.

REFERENCES:

1. Weiss, M. A., "Data Structures and Algorithm Analysis in C++", 4th Edition, Pearson Education, 2014.
2. Tanenbaum, A.M., Langsam, Y. and Augenstein, M.J., "Data Structures Using C", 2nd Edition, Pearson Education, 2009.
3. Horowitz, E., Sahni, S. and Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, University Press, 2011.
4. Samanta, D., "Classic Data Structures", 2nd Edition, PHI, 2009

COURSE OUTCOMES (COs)

After completion the above subject, students will be able to understand

1. A comprehensive understanding of fundamentals data structures
2. Implement and compare the fundamental data structures
3. Develop programs on their own for advanced data structures
4. Correlate the use of data structures in real life situations
5. Confidence to develop programs for complex problems with improved performance

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO302.1	3	2	-	-	-	-	-	3	-	3	3	-	2	3	2
CO302.2	-	1	-	-	-	-	-	3	-	3	3	-	2	3	2
CO302.3	-	1	-	-	-	-	-	3	2	3	3	-	2	3	2
CO302.4	-	2	1	1	-	-	-	3	2	3	3	-	2	3	2
CO302.5	-	1	-	1	-	-	-	3	-	3	3	-	-	-	-
CO302	3	1.7	1	1	-	-	-	3	2	3	3	-	2	3	2

EI7503 INDUSTRIAL INSTRUMENTATION II LT P C
3 0 0 3

COURSE OBJECTIVES

1. To make students understand the various measuring techniques for flow and level
2. To make students understand different type of transmitters.

UNIT I VARIABLE HEAD TYPE FLOWMETERS 9

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

UNIT II QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS 9

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

UNIT III ELECTRICAL TYPE FLOW METERS 9

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

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UNIT IV LEVEL MEASUREMENT **9**

Level measurement: Float gauges – Displacer type – Bubbler system – Load cell – Conductivity sensors – Capacitive sensors – D/P methods – Nucleonic gauge – Ultrasonic gauge, DIP ultrasonic sensors – Boiler drum level measurement: Differential pressure and Hydra step methods – Solid level measurement.

UNIT V TRANSMITTERS **9**

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Ability to understand the working principle of measuring instruments for flow and level.
2. Potential to identify and select the appropriate instrument for a given process measurement problem.
3. Select and use appropriate concepts and methods to solve problems effectively.
4. Competent to demonstrate the installation procedure for different measuring instruments.
5. Ability to calibrate measuring instruments.
6. Expertise to choose appropriate field transmitter for sensing different parameter in industrial environment.

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. Jain, R.K., "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 1999.
3. Singh, S.K., "Industrial Instrumentation and Control", Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2009.
4. Jayashankar, V., "Lecture Notes on Industrial Instrumentation", NPTEL, E-Learning Course, IIT Madras.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO303.1	1	1	2	2	-	1	1	-	-	-	-	1	2	-	-
CO303.2	2	3	2	3	-	1	2	1	-	-	-	1	3	-	-
CO303.3	3	3	2	3	-	1	2	-	-	-	-	1	3	-	-
CO303.4	2	1	2	1	-	1	1	-	-	-	-	1	3	-	-
CO303.5	1	1	1	1	-	1	1	-	-	-	-	1	3	-	-
CO303.6	3	2	2	3	-	1	2	1	-	-	-	1	3	-	-
CO303	2	1.8	1.8	2.1	-	1	1.5	1	-	-	-	1	2.8	-	-

EI7504 MICROPROCESSORS, MICROCONTROLLERS AND APPLICATIONS

L T P C
3 0 0 3

COURSE OBJECTIVES

1. To get familiarized with architecture, addressing modes and instructions of 8085 & 8086 microprocessor.
2. To get exposed to high Performance and advanced architectures.
3. To gain knowledge on essential peripherals and the associated interfacing ICs.
4. To get acquainted with 8-bit microcontroller and be able to program in assembly and C language.
5. To design microcontroller based system/application.

UNIT I ARCHITECTURE OF 8085/8086 PROCESSOR **9**

Evolution of Microprocessors – Introduction to 8085 – Architecture – Addressing Modes – Timing diagrams – Introduction to 8086 – Architecture – Maximum mode – Minimum mode – Addressing Modes & Programming.

UNIT II ADVANCED ARCHITECTURES **9**

Road to Higher Performance – Past and current Performance, Trends in Processor – Pipeline concepts and Performance – Superscalar Processing – Hardware Accelerators – Multiprocessor – RISC and CISC Processors – Nano Programming – Case study

UNIT III PERIPHERALS AND THEIR INTERFACING **9**

Programmable Peripheral Interface (8255) - Keyboard display controller (8279) – ADC – DAC Interface – Programmable Timer Controller (8254) – Programmable interrupt controller (8259) – Serial Communication Interface (8251) – DMA Controller (8257).

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UNIT IV MICROCONTROLLER ARCHITECTURE & PROGRAMMING 9

8051 Microcontroller – Architecture – Instruction Set – Addressing modes – Interrupts – Assembly Language Programming - Programming 8051 Timers – Serial Port Programming – Interrupts Programming – 8051 Programming in C.

UNIT V 8051: INTERFACING AND SYSTEM DESIGN 9

LCD & Keyboard Interfacing – ADC, DAC interfacing – External Memory interfacing – Sensor Interfacing – Motor Control – Relay – PWM – DC & Stepper Motor – Design of traffic light control and Washing machine control.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the architectural features and instruction set of microprocessors and microcontrollers.
2. Ability to effectively utilize the gained fundamental knowledge to get updated over the state-of-the-art Microprocessor technology.
3. Ability to configure and utilize the services of various peripheral devices associated with microprocessors and microcontrollers.
4. Ability to interface real world field devices with microcontrollers with the purpose of designing embedded systems for process control applications.
5. Ability to provide suitable software solutions for embedded applications.
6. Ability to adopt best practices in system design to meet the requirements of the given real-world problem

TEXT BOOKS:

1. Ramesh S. Gaonkar, "Microprocessor Architecture Programming and Applications with 8085", 6th edition, Penram International Publishing, 2013.
2. Douglas V. Hall, "Microprocessor and Interfacing, Programming and Hardware", Revised 2nd Edition, Indian edition 2007, 11th Reprint 2010, Tata McGraw-Hill.

REFERENCES:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D.MCKinlay, "The 8051
2. Microcontroller and Embedded Systems", 2nd Edition 2008, 5th Reprint, 2010, Pearson Education.
3. Krishna Kant, "Microprocessor and Microcontroller Architecture programming and system design using 8085, 8086, 8051, 8096, PHI", 7th Reprint 2011.
4. Ray, A.K. and Bhurchandi, K.M., "Advanced Microprocessor and Peripherals", 2nd Edition, Tata McGraw-Hill, 2007.
5. Kenneth J. Ayala, "The 8051 Microcontroller", 3rd Edition, Thompson Delmar Learning, 2007, New Delhi.

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6. Dogan Ibrahim, “Microcontroller Based Applied Digital Control”, John Wiley & Sons Ltd, 2006.
7. John P.Hayes, “Computer Architecture & Organization”, 3rd Edition, Tata McGraw-Hill, 1998.
8. Behrooz Parhami, “Computer Architecture from Microprocessor to supercomputer”, Oxford Publishing, 2014 Indian Reprint.
9. Krishna Kumar, “Lecture Notes on Microprocessors and Microcontrollers”, NPTEL, E-Learning Course, IISc Bangalore.
10. Pramod Agarwal, “Lecture Notes on Microprocessor”, NPTEL, E-Learning Course, IIT Roorkee.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO304.1	3	2	2	3	2	-	-	1	1	2	1	3	1	1	1
CO304.2	3	2	2	2	2	-	-	1	1	2	1	3	1	1	
CO304.3	3	2	2	2	2	-	1	1	1	2	1	3	1	1	1
CO304.4	3	2	2	2	2	-	1	1	1	2	1	3	1	1	1
CO304.5	3	3	3	3	3	1	1	1	1	2	1	3	1	1	1
CO304.6	3	2	3	2	3	2	2	1	1	2	1	3	1	1	1
CO304	3	2.1	2.3	2.3	2.3	1.5	1.2	1	1	2	1	3	1	1	1

EI7511 DATA STRUCTUES LABORATORY LT P C
0 0 4 2

COURSE BJECTIVES

1. To understand and implement basic data structures using C / C++
2. To apply linear and non-linear data structures in problem solving

LIST OF EXPERIMENTS

1. Implementation of selection sort, bubble sort and insertion sort.
2. Implementation of binary search and interpolation search.
3. Implementation of merge sort algorithm.
4. Implementation of quick sort algorithm.
5. Conversion of infix expression into postfix expression.
6. Evaluation of postfix expression; validation of parenthesis.
7. Implementation of insertion and deletions in a linked list.
8. Implementation of linear queue with a linked list.
9. Implementation of circular queue with an array.
10. Implementation of priority queues.
11. Implementation of binary search tree; traversals; sorting.

12. Implementation of heap sort from heap tree.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

After completion the above subject, students will be able to understand

1. A comprehensive understanding of fundamentals data structures
2. Implement and compare the fundamental data structures
3. Develop programs on their own for advanced data structures
4. Correlate the use of data structures in real life situations
5. Confidence to develop programs for complex problems with improved performance

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO307.1	3	2	-	-	-	-	-	-	-	-	-	-	2	3	2
CO307.2	-	1	-	-	-	-	-	-	-	-	-	-	2	3	2
CO307.3	-	1	-	-	-	-	-	-	2		-	-	2	3	2
CO307.4	-	2	1	1	-	-	-	-	2	1	-	-	2	3	2
CO307.5	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO307	3	1.7	1	1	-	-	-	-	2	1	-	-	2	3	2

EI7512 MICROPROCESSOR AND INTERFACING LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES

1. To develop skill in program writing for 8085, 8086 processors and 8051microcontroller.
2. To gain Practical knowledge on interfacing hardware and associated software.
3. To get trained to Programming and interfacing using simulators.
4. To get exposed to programming and interfacing using ARM7, ARM11, MSP430, and PIC microcontroller.

LIST OF EXPERIMENTS

ASSEMBLY LANGUAGE PROGRAMMING

1. a) Understanding the instruction set of 8085 µp.
   b) PROGRAMMING using Arithmetic, Logical instructions of 8085 microprocessor.
2. a) Understanding the instruction set of 8086 µp.
   b) Programming using String manipulation instructions (Compare & Scan) of 8086 microprocessor.
3. a) Understanding the instruction set of 8051 µc.

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b) Programming using Arithmetic, Logical and Bit manipulation instructions of 8051 microcontroller

SIMULATION EXPERIMENTS

4. Turbo assembler Programming (using arithmetic, logical, string instructions) of 8086.
5. Interfacing Keyboard / LCD with µc.
6. Interfacing ADC/DAC/ stepper motor with µc.

Hardware based Experiments using 8085 / 8086 / 8051 / ARM7 / ARM11 / MSP430 and PIC MICROCONTROLLER

7. Interfacing ADC and DAC with µp / µc.
8. Data transfer between computer and µp / µc.
9. a) Interfacing Keypad (4 x 4) with µp / µc.
   b) Interfacing LCD with µp / µc .
   . 10. **I^2C** based RTC/ EEPROM/ 7-Segment display Interface with µp / µc.
11. Interfacing limit Switches/ Push buttons/ Solenoid valves/ Pumps with µp / µc.
12. a) Realization of PID algorithm in µp / µc.
    b) µp / µc based control of temperature / Level process.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Ability to apply the acquired knowledge over the architectural features and instruction set of microprocessors and microcontrollers to come up with the right solution for a given task.
2. Ability to acquire real world signals using suitable data converters for process control applications.
3. Ability to interface real world field devices with microprocessors and microcontrollers with the purpose of designing embedded systems for Industrial automation.
4. Ability to effectively utilize various engineering design tools to perform real time simulation, PCB design for electronic prototyping and embedded system design.
5. Ability to analyze the requirements of a given application and use appropriate communication protocols.
6. Ability to analyze the given problem in hand and come up with suitable embedded solution.
7. Ability to demonstrate the acquired skills in multidisciplinary environments as a team member/leader.
8. Ability to professionally document the results obtained through experimental analysis.

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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO308.1	3	3	3	3	3	-	-	3	1	3	3	3	1	1	1
CO308.2	3	2	2	3	3	-	1	3	1	3	3	3	1	1	1
CO308.3	3	2	3	3	3	-	1	3	1	3	3	3	1	1	1
CO308.4	3	2	3	2	3	-	-	3	1	3	3	3	1	1	1
CO308.5	3	3	2	3	3	-	-	3	1	3	3	3	1	1	1
CO308.6	3	3	3	3	3	2	2	3	1	3	3	3	1	1	1
CO308.7	3	3	3	3	3	-	-	3	1	3	3	3	1	1	1
CO308.8	3	1	1	1	3	2	-	3	3	3	3	3	1	1	1
CO308	3	2.3	2.5	2.6	3	2	1.3	3	1.2	3	3	3	1	1	1

EI7601 DISCRETE TIME SIGNAL PROCESSING

L T P C
4 0 0 4

COURSE OBJECTIVES

1. To introduce the basic concepts of Digital Signal processing.
2. To make the students familiarize various mathematical tools for analyzing Discrete Time Systems.
3. To make the students design Digital Filters based on the Filter specifications.
4. To provide the exposure to the architectures of DSP processors.
5. To implement various algorithms in DSP for solving Real-time problem.

UNIT I INTRODUCTION 12

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

UNIT II DFT AND FFT 12

DFT properties, magnitude and phase representation – Direct computation of DFT – FFT: Radix 2 DIT & DIF algorithms, computational complexity, DFT and IDFT using FFT algorithms.

UNIT III DIGITAL IIR FILTERS 12

Introduction, design procedures for digital IIR filters, frequency transformation techniques – Digital Butterworth and Chebyshev IIR filter design using impulse invariant and bilinear transformation – Realization of IIR filters.

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UNIT IV DIGITAL FIR FILTERS **12**

Introduction, advantages of FIR over IIR filters - linear phase filters – Windowing technique: Rectangular, Triangular, Hamming, Hanning and Kaiser windows – Realization of FIR filter structures.

UNIT V FINITE WORD LENGTH EFFECTS AND DSP PROCESSORS **12**

Finite word length Effect – Fixed and floating point number representation, Quantization errors – Finite word length effects in IIR and FIR filters – Introduction to DSP architectures – addressing modes and Instruction set.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. Ability to remember the fundamentals of deterministic / stochastic processes, filters and adaptive signal processing.
2. Ability to understand the various types of digital filters used for signal processing
3. Ability to apply the mathematical tools such as DFT and FFT algorithms for discrete time signal processing
4. Ability to analyze the digital filter characteristics in time and frequency domains
5. Ability to evaluate the characteristics of any given system to design digital filters with required specifications
6. Ability to solve complex problems in Digital Filter Design and systems for Discrete Time Signal Processing

TEXT BOOKS:

1. Proakis, J.G., and Manolakis, D.G., "Digital Signal Processing Principles, Algorithms and Applications", Pearson Education, New Delhi, 2003 / PHI.
2. Johnson, J.R., "Introduction to Digital Signal Processing", Prentice Hall of India, 2009.

REFERENCES:

1. Mitra, S.K., "Digital Signal Processing" – A Computer Based Approach, Tata McGraw-Hill, 2001.
2. Uyemura, J.P., "A first course in Digital System Design An integrated approach", Cengage Learning, 2000.
3. Lonnie C.Ludeman, "Fundamentals of Digital Signal Processing" John Wiley & Sons,1986.
4. NPTEL Video Lecture series on, "Digital Signal Processing" by Prof. S.C. Dutta Roy, IIT Delhi.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO309.1	3	2	1	2	1		-	-	-	-	-	1	-	-	-
CO309.2	3	2	1	2	1	1	-	-	-	-	-	1	2	-	-
CO309.3	3	2	2	3	3	-	-	-	-	-	-	1	-	-	-
CO309.4	2	3	-	3	2	-	2	-	-	-	-	2	2	3	1
CO309.5	2	3	3	3	2	-	2	-	-	-	-	2	-	3	1
CO309.6	3	3	3	3	3	2	-	-	-	-	-	3	3	3	1
CO309	2.6	2.5	1.6	2.6	2	1.5	2	-	-	-	-	1.6	2.3	3	1

EI7602 PROCESS CONTROL LT P C
4 0 0 4

COURSE OBJECTIVES

1. To introduce technical terms and nomenclature associated with Process control domain.
2. To familiarize the students with characteristics, selection, sizing of control valves.
3. To introduce students to the fundamentals of system identification.
4. To provide an overview of the features associated with Industrial type PID controller.
5. To make the students understand the various PID tuning methods.
6. To elaborate different types of control schemes such as cascade control, feed-forward control and Model Based control schemes.

UNIT I PROCESS DYNAMICS 12

Need for process control – Hierarchical decomposition of control functions – Servo and regulatory operations – Continuous and Batch processes – Mathematical Modeling of Processes: Level, Flow and Thermal processes – Lumped and Distributed parameter models – Degrees of Freedom – Interacting and non-interacting systems – Self regulation – Linearization of non-linear systems – Dynamic behavior of processes.

UNIT II CONTROL VALVE 12

Actuators: Pneumatic and electric actuators – I/P converter – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Valve body: Commercial valve bodies – Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves – Cavitation and flashing – Materials for Control Valves – Control Valve selection

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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 and Direct/reverse action – Realization of PID Controller using Analog Circuits – Introduction to fractional order PID controller

UNIT IV PID CONTROLLER TUNING – SINGLE LOOP REGULATORY CONTROL & ENHANCEMENT TO SINGLE LOOP REGULATORY CONTROL 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 – Inferential control – Split-range – override control – Adaptive Control

UNIT V MODEL BASED CONTROL SCHEMES & INTRODUCTION TO MULTI-LOOP REGULATORY CONTROL & CASE –STUDIES 12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES (COS)

1. Ability to understand technical terms associated with Process control domain.
2. Ability to develop models using first principles approach for processes such as level, flow, temperature and pressure as well as analyze models.
3. Ability to recommend the right type of control valve along with its characteristics for a given application.
4. Ability to size a control valve following the procedure outlined in the ISA S 75.01 standard.
5. Ability to design & implement a suitable control scheme for a given process and validate through simulations.
6. Ability to analyze various control schemes and recommend the right control strategy for a given application.
7. Ability to use appropriate software tools (Example: MATLAB/SCILAB) for analysis, design and implementation of Process Control System.

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TEXT BOOKS:

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

REFERENCES:

1. Michael King, "Process Control: A Practical Approach", Wiley, 2010.
2. Baumann, H.D., "Control Valve Primer – A User's Guide", ISA, 2008.
3. Antonio Visioli, "Practical PID Control" Springer- Verlag London, 2006.
4. Aidan O'Dwyer, "Handbook of PI and PID Controller Tuning Rules", Imperial College Press, 2009.
5. George Stephanopoulos, "Chemical Process Control – An Introduction to Theory and Practice", Prentice Hall of India, 2005.
6. Bela G. Liptak, "Instrument Engineers' Handbook", 4th Edition, Volume Two: Process Control and Optimization, CRC Press, 2005.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
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CO310.2	3	3	3	3	2	-	2	1	-	1	2	-	-	3	-
CO310.3	3	3	3	3	2	2	-	1	-	1	-	-	-	3	-
CO310.4	3	3	3	3	2	2	-	1	-	1	-	-	-	3	-
CO310.5	3	3	3	3	3	2	-	1	-	1	-	2	-	3	-
CO310.6	3	3	3	3	3	2	-	1	-	1	-	2	-	3	-
CO310.7	3	3	3	3	3	2	-	1	-	1	-	2	-	3	-
CO310	3	3	3	3	2.43	2	2	1	-	1	2	2	-	3	-

EI7603 PROJECT MANAGEMENT AND FINANCE LT P C
3 0 0 3

COURSE OBJECTIVES

1. To outline the need for project management.
2. To outline the importance of finance and accounting.
3. To demonstrate knowledge and understanding of the engineering and management principles.
4. To function effectively as an individual, and as a member or leader in diverse teams.

UNIT I PROJECT MANAGEMENT, PROJECT SELECTION AND PROJECT 9

Objectives of project management –Types of Projects – Project Management Life Cycle –Project Selection – Feasibility study – Estimation of Project Cost – Cost of Capital – Network analysis Techniques – PERT – CPM.

UNIT II PROJECT IMPLIMENTATION, MONITORING AND CONTROL 9

Project representation and preliminary manipulations – Basic Scheduling concepts –Resource leveling – Resource allocation – Setting a base line – Project management information system – Importance of contracts in projects – Team work in Project Management – Formation of Effective terms.

UNIT III PROJECT EVALUATION, AUDITING AND OTHER RELATED TOPICS IN PROJECT MANAGEMENT 9

Project Evaluation – Project auditing – Phase of project audit – Project closure reports, computers, e-markets in Project Management.

UNIT IV FINANCE AND ACCOUNTING 9

Source of finance – Term Loans – Capital Structure – Financial Institution Accounting Principles – Preparation and Interpretation of balance sheets and profit and loss statements - Fixed Assets – Current assets – Depreciation methods – Break even analysis.

UNIT V WORKING CAPITAL MANAGEMENT AND CAPITAL BUDGETING 9

Current assets management – Estimation of working capital requirements – Capital budgeting – Capital budgeting methods – Pack back method – Present value method – Accounting rate of return methods.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Selecting the project and identify the easy method to manage project within finance.
2. Implementing the role and responsibility by selecting suitable method in the project management.
3. The project work manage and carried out by the engineer within the finance.
4. Performance analysis on the project has been manage within the finance.
5. Demonstrate budget with the working capital and apply them with suitable methods.

TEXT BOOKS:

1. Paneer Selvam, R., and Senthilkumar, P., “Project Management”, PHI, 2011.
2. James C.Van Horne, “Fundamentals of Financial Management”, Person Education 2004.

REFERENCES:

1. Khanna, R.B., “Project Management”, PHI 2011.
2. Prasanna Chandra, “Financial Management”, Tata McGraw-Hill,2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
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CO311.2	3	-	-	-	-	2	-	2	3	3	3	3	2	-	-
CO311.3	3	-	1	-	-	1	-	2	2	1	3	3	2	-	-
CO311.4	3	3	2	-	-	2	-	2	-	1	3	3	2	-	-
CO311.5	3	2	1	-	-	1	-	2	-	1	3	3	2	-	-
CO311	3	2.5	1.3	-	-	1.6	-	2	2.6	1.8	3	3	2.2	-	-

HS7551 EMPLOYABILITY SKILLS L T P C
3 0 0 3

COURSE DESCRIPTION

This course aims to help the students acquire the employability skills necessary for the workplace situations. It also attempts to meet the expectations of the employers by giving special attention to language skills, presentation skills, group discussion skills and soft skills. This will be achieved through expert guidance and teaching activities focusing on employability skills.

COURSE OBJECTIVES

1. To enhance the employability skills of students with a special focus on presentation skills, group discussion skills and interview skills
2. To help them improve their reading skills, writing skills, and soft skills necessary for the workplace situations
3. To make them employable graduates

UNIT I READING AND WRITING SKILLS 9

Reading: skimming & scanning strategies – note making skills – interpreting visual material (charts & tables) – critical reading – fast reading necessary for reading letters & files - preparing job applications - writing covering letter and résumé - applying for jobs online - email etiquette – writing official letters (placing an order, letters to consumers, etc.) writing reports – collecting, analyzing and interpreting data.

UNIT II SOFT SKILLS 9

Hard skills & soft skills – soft skills: self-management skills & people skills - training in soft skills - persuasive skills – sociability skills –interpersonal skills – team building skills – leadership skills – problem solving skills – adaptability - stress management – motivation techniques – life skills

UNIT III PRESENTATION SKILLS 9

Preparing slides with animation related to the topic – organizing the material - Introducing oneself to the audience – introducing the topic – answering questions – individual presentation

practice— presenting the visuals effectively – 5 minute presentation.

UNIT IV GROUP DISCUSSION SKILLS **9**

Participating in group discussions – understanding group dynamics - brainstorming the topic -– questioning and clarifying –GD strategies (expressing opinions, accepting or refusing others opinions, turn taking) – activities to improve GD skills – viewing recorded GD - mock GD.

UNIT V INTERVIEW SKILLS **9**

Interview etiquette – dress code – body language – mock interview -–attending job interviews – answering questions confidently – technical interview – telephone/Skype interview - practice in different types of questions – one to one interview &panel interview – FAQs related to job interview Emotional and make presentations and participate in group discussions with high level of self-confidence. • Students will be able to perform well in the interviews • They will have adequate reading and writing skills needed for workplace situations

REFERENCES:

1. Corneilssen, Joep. How to Prepare for Group Discussion and Interview. New Delhi: TataMcGraw-Hill, 2009.
2. Dabreo, Desmond A. Group Discussion and Team Building. Mumbai: Better Yourself Books, 2004.
3. Ramesh, Gopalswamy, and Mahadevan Ramesh. The ACE of Soft Skills. New Delhi: Pearson, 2010.
4. Gulati, Sarvesh. Corporate Soft Skills. New Delhi: Rupa and Co. 2006.
5. Van Emden, cultural intelligence.

TOTAL :45 PERIODS

COURSE OUTCOMES (CO)

After completion the above subject

1. Students will be able to make presentations with high level of self-confidence.
2. Students will be able to participate in group discussions with confidence.
3. Students will have a good soft skill capability.
4. Students will be able to perform well in the interviews.
5. They will have adequate reading and writing skills needed for workplace situations.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO312.1	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3
CO312.2	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3
CO312.3	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3
CO312.4	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3
CO312.5	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3
CO312	3	3	3	3	1	2	1	3	2	3	2	3	3	3	3

EI7611 INDUSTRIAL INSTRUMENTATION LABORATORY LT P C
0 0 4 2

COURSE OBJECTIVES

1. To make the students aware about calibration of meters, sensors and transmitters.
2. To make the students conscious about the working and operation of different types of analytical Instruments.
3. To identify, formulate, and analyze problems regarding sensors and transmitter
4. To use research-based knowledge and research methods for interpretation of data from sensors.

LIST OF EXPERIMENTS

1. a) Testing of pressure gauge using dead weight tester.
b) Level measurement using d/p transmitter including elevation consideration.
2. a) Calibration of thermocouple and RTD using temperature calibrator.
b) Calibration of temperature transmitter using multifunction calibrator.
3. Calibration of ammeter, voltmeter and wattmeter using multifunction calibrator.
4. a) Calibration and configuration of smart transmitter using HART communicator.
b) Calibration and configuration of transmitters using loop calibrator.
5. Measurement of Absorbance and Transmittance of Test solutions using UV-Spectrometer.
6. Monitoring Physiological Parameters using Vital signs monitor.
7. Measurement of Conductivity, pH and Viscosity of Test solutions.
8. Interfacing Different types of flow meter with PC using DAQ.
9. Determination of stoichiometry ratio in a combustion process.
10. a)Temperature Measurement using IR Thermometer.
b) Measurement of Level and Pressure using fiber optics system.
11. a) Testing of Rotameter.
b) Installation of d/p based level Transmitter.
12. Design and Testing of Electromagnetic Flow meters.

TOTAL : 60 PERIODS

COURSE OUTCOMES

1. Ability to determine the time response and frequency response of given systems such as mechanical, electrical, hydraulic systems using suitable tools.
2. Ability to design, realize and validate lag / lead / lag-lead compensators for a given single input and single output system.
3. Ability to analyze and design control scheme for an open loop unstable system and MIMO system.
4. Ability to determine the static and dynamic characteristics of torque, speed, density and level measuring instruments.

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5. Ability to quantify uncertainty associated with measuring instruments.
6. Ability to interface field instruments with PC using DAQ cards.
7. Ability to configure smart transmitters using HART communicator.
8. Ability to communicate efficiently the engineering facts and function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO315.1	1	1	-	-	-	-	-	3	-	3	3	-	-	-	-
CO315.2	1	-	-	1	-	-	-	3	-	3	3	-	-	-	-
CO315.3	-	-	-	1	1	-	-	3	-	3	3	-	-	-	-
CO315.4	1	-	-	-	-	-	-	3	-	3	3	-	1	1	2
CO315.5	-	1		1	2	1	1	3	-	3	3	1	1	1	2
CO315.6	-	-	1	1	1	-	-	3	-	3	3	2	1	1	2
CO315.7	-	-	1	1	1	-	-	3	-	3	3	1	1	1	2
CO315.8	-	-	-	-	-	-	-	3	1	3	3	-	-	-	-
CO315	1	1	1	1	1.2	1	1	3	1	3	3	1.3	1	1	2

EI7612 PROCESS CONTROL LABORATORY LT P C
0 0 4 2

COURSE OBJECTIVES

To impart theoretical and practical skills in

1. Process Identification
2. Tuning of PID controller including Auto-tuning
3. PID Enhancements (Cascade and Feed-forward Control Schemes) and
4. Design and Implementation of basic and advanced Control schemes using the facilities available in the Process Control lab.

LIST OF EXPERIMENTS

Simulation Based Experiments

1. Interpretation of P & ID (ISA S5.1)

2. Simulation of Lumped/ Distributed Parameter System.
3. Identification of Transfer function model of a Typical Industrial Process using nonparametric identification methods.
4. Design and Implementation of Practical Forms of PID Controller on the simulated model of a Typical Industrial Process.

5. Design and Implementation of Feed forward and Cascade control schemes on the simulated model of a Typical Industrial Process.
6. (i) Analysis of MIMO system.
   (ii) Design and implementation of Multi-loop PID schemes on the simulated model of a Typical Industrial Process.

Hardware Based Experiments (Experiments Carried out On the Skid Mounted Plants)

7. (i) Study of a Process Control Training plant.
   (ii) Determination of characteristics of a Pneumatically Actuated Control valve (with and without Positioner).
8. Design and implementation of ON-OFF controller for the Temperature Process.
9. Control of flow process using industrial type PID controller.
10. PC based control of level process.
11. On-line monitoring and control of a pilot plant using an industrial type distributed control system.
12. Design and implementation of advanced control scheme (adaptive controller or model predictive Control scheme) on the skid mounted pilot plant.

TOTAL : 60 PERIODS

COURSE OUTCOMES(COs)

1. Ability to work and measure parameter of flow/ level / temperature / pressure from SKID mounted pilot plant.
2. Ability to analyze, design suitable control schemes for industrial type process.
3. Ability to design ON-OFF, feed forward, cascade and multiloop PID controllers for the typical industrial process.
4. Ability to use appropriate software tools for design, analysis and implementation of control scheme.
5. Ability to experimentally measure industrial process parameters (such as flow, viscosity and humidity) and physiological parameters of the human body.
6. Ability to configure and interface different field devices with PC.
7. Ability to select, design, install and operate field devices for measurement of flow, temperature and pressure through a typical industrial case study(combustion process).
8. Ability to experimentally verify electrical safety of an instrument.
9. Ability to communicate efficiently the engineering facts and function actively and efficiently as an individual or a member/leader of different teams and multidisciplinary projects.

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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO, PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO316.1	1	-	-	-	-	-	-	3	-	3	3	-	-	-	-
CO316.2	1	1	-	-	-	-	-	3	-	3	3	-	-	-	-
CO316.3	1	-	-	1	-	-	-	3	-	3	3	-	-	-	-
CO316.4	1	-	-	-	1	-	-	3	-	3	3	-	-	-	-
CO316.5	1	1	1	-	-	1	1	3	-	3	3	-	1	1	-
CO316.6	2	2	2	1	-	-	-	3	-	3	3	-	1	1	-
CO316.7	2	2	2	1	1	-	-	3	-	3	3	2	1	1	-
CO316.8	1	1	1	2	1	1	-	3	-	3	3	-	1	1	-
CO316.9	-	-	-	-	-	-	-	3	1	3	3	-	-	-	-
CO316	1.2	1.4	1.5	1.3	1	1	1	3	1	3	3	2	1	1	-

EI7701 COMPUTER CONTROL OF PROCESSES LT P C
4 0 0 4

COURSE OBJECTIVES

1. To represent the linear time invariant System in discrete State Space form.
2. To analyze the controllability, observability and stability of a Discrete Time System.
3. To estimate model parameters from input/output measurements.
4. To design Digital Controllers.
5. To design controllers for multi-loop and multivariable systems.

UNIT I DISCRETE STATE-VARIABLE TECHNIQUE 12

State equation of discrete time system with sample and hold – State transition equation – Methods of computing the state transition matrix – Decomposition of discrete time transfer functions – State diagram representations of Discrete time systems - Controllability and observability of linear time invariant discrete time system – Stability tests of discrete time system – State Observer.

UNIT II SYSTEM IDENTIFICATION 12

Non-Parametric methods: Transient analysis – Frequency analysis – correlation analysis – Spectral analysis – Parametric methods: Least square method – Recursive least square method.

UNIT III DIGITAL CONTROLLER DESIGN 12

Review of z-transform – Modified of z-transform – Pulse transfer function – Digital PID controller – Dead-beat controller and Dahlin's controller – Smith Predictor – Digital Feed-forward controller – Internal Model Controller.

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UNIT IV MULTI-LOOP REGULATORY CONTROL 12

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 - Decoupling Control.

UNIT V MULTI-VARIABLE REGULATORY CONTROL 12

Introduction to Multivariable control – Multivariable PID Controller – Multivariable Internal Model Controller – Multivariable Dynamic Matrix Controller – Generalized Predictive Controller.

TOTAL : 60 PERIODS

COURSE OUTCOMES(COs)

1. Understand and apply the basics of discrete systems to find the solutions for problems.
2. Build mathematical models by parametric and non parametric methods using software tools.
3. Obtain the controllability, observability and stability of discrete time systems.
4. Understand the performance of MIMO system.
5. Develop multi-loop and multivariable control for real time MIMO system.
6. Design digital controllers for a process.

TEXT BOOKS:

1. Sigurd Skogestad, Ian Postlethwaite, **"**Multivariable Feedback Control: Analysis and Design", John Wiley and Sons, 2005.
2. Gopal, M., "Digital Control and State Variable Methods", Tata McGraw-Hill, 2003.

REFERENCES:

1. Stephanopoulos, G., "Chemical Process Control - An Introduction to Theory and Practice", Prentice Hall of India, 2005.
2. Soderstorm, T. and Stoica, P., "System Identification", Prentice Hall International Ltd., UK., 1989.
3. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, "Process Dynamics and Control", Wiley John and Sons, 3rd Edition, 2010.
4. P. Albertos and A. Sala, "Multivariable Control Systems An Engineering Approach", Springer Verlag, 2006.
5. Bequette, B.W., "Process Control Modeling, Design and Simulation", Prentice Hall of India, 2008.
6. E. Ikonen and K. Najim, "Advanced Process Identification and Control", Marcel Dekker, Inc., Newyork, 2002.

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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO401.1	3	2	2	-	-	-	-	1	-	1	-	2	-	-	-
CO401.2	3	-	3	-	3	-	-	1	-	1	-	-	-	-	3
CO401.3	3	3	-	-	-	-	-	1	-	1	-	-	2	-	-
CO401.4	3	-	3	-	-	-	-	1	-	1	-	-	3	-	-
CO401.5	3	-	3	-	-	-	-	1	-	1	-	2	3	-	-
CO401.6	3	-	3	-	-	2	1	1	-	1	-	2	3	-	-
CO401	3	2.5	2.8	-	3	2	1	1	-	1	-	2	2.7	-	3

EI7702 LOGIC AND DISTRIBUTED CONTROL SYSTEM LT P C
3 0 0 3

COURSE OBJECTIVES

1. To give an overview of the automation technologies such as PLCs, SCADA and DCS used in industries.
2. To provide a fundamental understanding of the different languages used for PLC programming.
3. 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.

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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 (CO)

1. Able to gain understanding/knowledge on field devices, I/O modules, Industrial controllers like PLC, SCADA and DCS of Industrial Automation system
2. Able to formulate a discrete control problem and arrive at developing a control solution by PLC ladder program and other programming languages
3. Able to synthesize the solution for complex problems and provide alternate solutions by means of other programming languages of PLC
4. Able to Identify an application that requires Distributed control system and provide an integrated solution using DCS
5. Able to select and apply appropriate technique for Automation by learning advanced topics in Automation.

TEXT BOOKS:

1. Petruzella, F.D., "Programmable Logic Controllers", 3rd Edition, Tata McGraw-Hill, 2010.
2. Lucas, M.P., "Distributed Control System", Van Nostrand Reinhold Company, New York, 1986.

REFERENCES:

1. Clarke, G., Reynders, D. and Wright, E. "Practical Modern SCADA Protocols: DNP3, IEC 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, McGrawHill 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

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO402.1	3	3	2	2	2	1	1	-	1	1	1	3	-	-	3
CO402.2	3	3	2	2	3	2	1	-	1	1	1	3	-	-	3
CO402.3	3	3	2	2	3	2	1	-	1	1	1	3	-	-	3
CO402.4	3	3	2	2	3	2	1	-	1	1	1	3	-	-	3

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CO402.5	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**-**	**1**	**1**	**1**	**3**	**-**	**-**	**3**
CO402	**3**	**3**	**2**	**2**	**2.8**	**1.8**	**1**	**-**	**1**	**1**	**1**	**3**	**-**	**-**	**3**

EI7711 INDUSTRIAL AUTOMATION LABORATORY LT P C
0 0 4 2

COURSE OBJECTIVES

To teach the importance of measurement for monitoring, control and to impart theoretical and practical skills in

1. Sensor Data acquisition, Data analysis, Data processing and Data visualization.
2. Interfacing Conventional and Smart Field Devices (Transmitters & Control Valves) with Industrial Type Programmable Logic Controller and Distributed Control System
3. Understanding the Instruction set of Programmable Logic Controller.
4. Programming of Industrial Type Programmable Logic Controller (Ladder Logic, Function Block Programming, Sequential Function Chart and Instruction List)

LIST OF EXPERIMENTS

1. Interfacing Level Transmitter and Control Valve with Personal Computer.
2. (i) Study of PLC Field Device Interface Modules (AI, AO, DI, DO Modules) (ii) Interfacing Analog/Digital Input/output Devices with Industrial Type PLC
3. Simple exercises using the Instruction Set of an Industrial Type PLC.
4. PLC Exercises-I (Hardware Implementation)
   i. Filling/draining control operation. ii. Reversal of DC motor direction.
5. PLC Exercises-II (Hardware Implementation)
   Traffic light control.
   Alarm Annunciator Sequence.
6. Control of Level Process using an Industrial Type PLC
7. Implementation of Discrete Control Sequence in PLC using Sequential Function Chart Programming method.
8. Implementation of Discrete Control Sequence in PLC using Instruction List Programming method.
9. (i) Study of DCS Field Device Interface Modules (AI, AO, DI, DO, H1 Modules)
   (ii) Interfacing Analog/Digital Input/Output Devices with an Industrial Type DCS
10. Implementation of Feedback Control Scheme in DCS using IEC 61131-3 Function Block Programming method.

11. (i) Interfacing HART and FF enabled Field Devices with Industrial Type DCS.
(ii) Demonstration of PID Control in Field Devices.
12. Interfacing Wireless HART enabled Field Devices with DCS.

TOTAL : 60 PERIODS

COURSE OUTCOMES(COs)

1. Gain hands on experience in working with Industrial Automation Systems (Industrial Type DCS & PLC)
2. Be able to Configure Function Blocks and develop Feedback Control Schemes.
3. Ability to monitor and control a pilot plant using Industrial Type DCS/PLC
4. Be able to analyze & interpret results and draw meaningful conclusions.
5. Be able to present the results in written and oral forms.
6. Ability to work as a member in a group.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO406.1	1	3	-	1	3	3	1	3	3	3	3	3	1	2	3
CO406.2	3	3	-	1	3	1	2	3	1	3	3	1	1	1	3
CO406.3	2	3	-	1	3	1	2	3	3	3	3	3	2	2	3
CO406.4	2	1	-	1	3	2	1	3	2	3	3	3	2	3	3
CO406.5	2	1	-	1	3	2	1	3	2	3	3	1	2	1	3
CO406.6	1	2	-	1	1	1	2	3	2	3	3	1	2	2	3
CO406	1.8	2.1	-	1	2.6	1.6	1.5	3	2.1	3	3	2	1.6	1.8	3

EI7712 INSTRUMENTAION SYSTEM DESIGN LABORATORY L T P C
0 0 4 2

COURSE OBJECTIVES

1. To impart knowledge on the design of signal conditioning circuits for the measurement of Level, temperature etc.
2. To develop the skills needed to design, fabricate and test Analog/ Digital PID controller, Data Loggers and Alarm Annunciator.
3. To develop various modules for final year project as per industrial standards and practices.
4. To make the student familiarize with the design of orifice and control valve sizing.

LIST OF EXPERIMENTS

1. Design, Fabrication and Testing of 2-wire Analog Transmitter.
2. Design, Fabrication and Testing of 2-wire Smart Transmitter.
3. Design, Fabrication and Testing of Data Logger.
4. Design of ON/OFF Controller for Thermal Process.
5. Design, Fabrication and Testing of Analog PID Controller.

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6. Design, Fabrication and Testing of Digital PID Controller.
7. Design, Fabrication and Testing of Alarm, Annunciation Circuits.
8. Design of Programmable Logic Controller using Microcontroller.
9. Development of Software Program for sizing Orifice.
10. Development of Software Program for sizing Control Valve.
11. Development of Software Program for sizing Rotameter.
12. a) Preparation of documentation of Instrumentation Project. (Process Flow Sheet, Instrument Index Sheet and Instrument Specification Sheet).
    (b) Preparation of Project Scheduling, Installation Procedure and Safety Regulations

TOTAL : 60 PERIODS

COURSE OUTCOMES(COs)

1. Ability to carry out the design and fabrication of conventional and smart transmitters for key process variables such as flow, level, pressure and temperature.
2. Potential to realize On/Off controllers, PID controllers and PLC.
3. Proficient to design data loggers and alarm circuits for an industrial application requirement.
4. Able to develop software programs for sizing control valve, orifice and rotameter.
5. Capable of preparing documentation for Instrumentation projects.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO407.1	3	3	3	2	3	1	1	3	2	3	3	1	2	3	-
CO407.2	3	3	3	3	3	1	2	3	2	3	3	1	2	3	3
CO407.3	3	3	3	2	3	1	2	3	2	3	3	1	2	3	-
CO407.4	3	3	3	2	3	1	1	3	2	3	3	1	2	3	-
CO407.5	3	3	3	2	-	1	1	3	3	3	3	1	2	3	-
CO407	3	3	3	2.2	3	1	1.4	3	2.2	3	3	1	2	3	3

EI7713 MINI PROJECT/INDUSTRIAL TRAINING (6 WEEKS-DURING SUMMER VACATION)/INTERNSHIP **LT P C 0 0 6 3**

COURSE OBJECTIVES

The student should be made to:

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

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3. prepare a good technical report.
4. Gain Motivation to present the ideas behind the project with clarity.
5. Get exposure to work in an industrial environment.

MINI PROJECT

To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs.

The progress of the mini project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The evaluation will be made based on this report and a viva- voce examination, conducted internally by a 3-member committee appointed by Head of the Department.

(OR)

INDUSTRIAL TRAINING/INTERNSHIP (6 WEEKS – DURING SUMMER VACATION)

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

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

TOTAL : 90 PERIODS

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COURSE OUTCOMES(COs)

1. At the end of the course, the student should be able to:
2. Select a good project and able to work in a team leading to development of hardware/software product.
3. Prepare a good technical report and able to present the ideas with clarity.
4. Gain Knowledge on various terminologies related to industrial environment.
5. Able to work efficiently as a member of different teams related to multidisciplinary projects.
6. Acquire skills to communicate efficiently and gain management skills related to industry / research organizations.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO408.1	1	1	1	1	-	-	-	3	-	3	3	-	3	3	3
CO408.2	3	2	3	2	1	1	1	3	1	3	3	-	3	3	3
CO408.3	2	3	2	3	1	1	1	3	1	3	3	1	3	3	3
CO408.4	-	-	1	1	-	-	-	3	-	3	3	3	3	3	3
CO408.5	-		-		-	2	-	3	-	3	3	2	3	3	3
CO408.6	-	-	-	-	-	-	-	3	-	3	3	-	3	3	3
CO408	2	2	1.75	1.75	1	2	1	3	1	3	3	3	3	3	3

EI7811 **PROJECT WORK** **L T P C**

0 0 20 10

COURSE OBJECTIVES

The student should be made to :learn methodology to select a good project and able to work in a team leading to development of hardware/software product .prepare a good technical report. GainMotivation to present the ideas behind the project with clarity.

A Project topic must be selected either from research literature or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen Comprehension of principles by applying them to a new problem which may be the design /fabrication of Sensor/Activator/Controller, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

TOTAL : 300 PERIODS

COURSE OUTCOMES (COs)

1.Ability to find solution for complex engineering problems applying the engineering knowledge.

2. Ability to formulate and analyze complex engineering problem.

3. Select and apply software tools required to solve the formulated problem
4. Ability to identify and find solution to societal issues
5.Ability to work as a member in a team
6. Ability to find solutions to the formulated problem using multidisciplinary engineering knowledge
7. Ability to communicate the engineering activity and to do effective documentation of the work carried out
8. Ability to use the knowledge obtained from project to engage in life -long learning

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO411.1	3	-	-	-	3	-	-	3	-	-	3	3	3	3	3
CO411.2	3	3	3	3	3	-	-	3	-	-	3	3	3	3	3
CO411.3	3	3	3	-	3	-	-	3	-	-	3	3	3	3	3
CO411.4	-	-	-	-	3	3	3	3	-	-	3	3	3	3	3
CO411.5	-	-	-	-	3	-	-	3	3	-	3	3	3	3	3
CO411.6	-	-	-	-	3	-	-	3	3	-	3	3	3	3	3
CO411.7	-	-	-	-	3	-	-	3	-	3	3	3	3	3	3
CO411.8	-	-	-	-	3	-	-	3	-	3	-	3	-	-	-
CO411	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

EI7001 ADVANCED TOPIC IN PID CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES

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

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UNIT III PID STABILIZATION **9**

Stabilization of Linear Time-invariant Plants using P/PI/ PID controllers – Optimal Design using PID Controllers – 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: 45 PERIODS

COURSE OUTCOMES(COs)

1. Ability to determine the advanced Features supported by the Industrial Type PID Controller.
2. Ability to Design, tune and implement P/PI/PID Controllers to achieve desired Performance for various processes.
3. Ability to analyse the stability and robustness of closed loop system with PID controller.
4. Ability to design and implement adaptive PID controllers and Non-linear PID Control schemes.
5. Ability to Analyze Fractional-order systems, Fractional-order- controller and Design 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.

Attested

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO001.1	2	3	2	2	3	1	-	1	1	2	1	3	**2**	-	3
CO001.2	2	2	3	3	2	1	-	1	1	2	1	3	**2**	-	3
CO001.3	2	3	3	3	2	1	-	1	1	2	1	3	**2**	-	3
CO001.4	2	3	2	2	3	1	-	1	1	2	1	2	**2**	-	3
CO001.5	2	2	3	2	2	1	-	1	1	2	1	2	**2**	-	3
CO001	**2**	**2.6**	**2.6**	**2.4**	**2.4**	**1**	**-**	**1**	**1**	**2**	**1**	**2.6**	**2**	**-**	**3**

EI7002 ANALYTICAL INSTRUMENTS L T P C

3 0 0 3

COURSE OBJECTIVES

1. To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopies.
2. To impart fundamental knowledge on gas chromatography and liquid chromatography.
3. 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.
4. To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
5. To understand the working principle, types and applications of NMR and Mass spectroscopy.

UNIT I SPECTROPHOTOMETRY 9

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

UNIT II CHROMATOGRAPHY 9

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

UNIT III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS 9

Gas analyzers – Oxygen, 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

Selective ion electrodes - Principle of pH and conductivity measurements - dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.

UNIT V NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)

1. On completion of this course, the students will be able to, understand the working principle behind different analytical methods in the industry.
2. Understand the basic operation of different analytical instruments and their applications.
3. Appreciate the strengths and limitations of various analytical instruments
4. Develop critical thinking for interpreting analytical data.
5. Select an appropriate analytical instrument for an industrial requirement.
6. Apply the theoretical knowledge gained to solve numerical problems related to analytical instrumentation.

TEXT BOOKS:

1. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2006.
2. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental methods of analysis", CBS publishing & distribution, 7th Edition, 2012.
3. Robert E. Sherman., "Analytical Instrumentation", Instruments Society of America, 1996.

REFERENCES:

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3

CO002.1	**3**	**1**	**1**	**1**	**3**	**1**	1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO002.2	**1**	**3**	**1**	**2**	**3**	**1**	1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO002.3	**1**	**1**	**1**	**1**	**3**	**2**	1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO002.4	**1**	**1**	**1**	**1**	**3**	**3**	1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO002.5	**3**	**3**	**2**	**1**	**1**	**1**	1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
CO002.6	**3**	**3**	**3**	**3**	**2**	**2**	1	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**-**
CO002	**2**	**2**	**1.5**	**1.5**	**2.5**	**1.6**	1	**1**	**1**	**1**	**1**	**1.16**	**1.16**	**1.16**	**1**

EI7003 APPLIED SOFT COMPUTING LT P C
3 0 0 3

COURSE OBJECTIVES

1. Get familiarized with different architectures and training algorithms of neural networks.
2. Get exposed to the various neural modeling and control techniques with case study using simulation tool box.
3. Gain Knowledge on fuzzy set theory and fuzzy rules.
4. Able to design and implement the fuzzy logic controller with case study using simulation tool box.
5. Capable of designing hybrid control schemes, selected optimization algorithms with case study using simulation tool box.

UNIT I ARTIFICIAL NEURAL NETWORK (ANN) 9

Introduction to ANN: Biological neuron, artificial neuron, activation function, Perceptron – Multi layer perceptron – Back propagation algorithm (BPA) – Recurrent neural network (RNN) – Adaptive resonance theory (ART) based network – Radial basis function (RBF) network – Online learning algorithms: BPA through time – RTRL algorithms – Reinforcement learning.

UNIT II NEURAL NETWORKS FOR MODELING AND CONTROL 9

Need for using ANN in Modeling and Control – Modeling of non-linear systems using ANN: Generation of training data, Identification of Optimal architecture, Model validation – Control of nonlinear systems using ANN: Direct and Indirect neuro control schemes – Adaptive neuro controller – Case study – Familiarization with neural network toolbox.

UNIT III FUZZY SET THEORY 9

Fuzzy set theory – Operation on fuzzy sets: Scalar cardinality, Fuzzy cardinality, Fuzzy union and intersection Fuzzy complement (Yager and Sugeno), Equilibrium points, Aggregation, Projection, Composition, Cylindrical extension, Fuzzy relation – Fuzzy membership functions.

UNIT IV FUZZY LOGIC FOR MODELING AND CONTROL 9

Modeling of non-linear systems using fuzzy models: TSK model – Fuzzy logic controller: Fuzzification, Knowledge base, Decision making logic, Defuzzification – Adaptive fuzzy

systems – Case Study – Familiarization with fuzzy logic toolbox.

UNIT V HYBRID CONTROL SCHEMES 9

Need for Hybrid control – Neuro-Fuzzy Control scheme – ANFIS – Case study – Familiarization with ANFIS toolbox – Introduction to Genetic Algorithm and Particle swarm optimization – Optimization of membership function and rule base using Genetic Algorithm – Introduction to Support vector machine.

TOTAL : 45 PERIODS

TEXT BOOKS :

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

REFERENCES:

1. Goldberg, D.E., "Genetic Algorithm in Search, Optimization and Machine learning", Addison Wesley Longman Publishing Company Inc. 1989.
2. Millon W.T., Sutton R.S. and Webrose P.J., "Neural Networks for Control", MIT press, 1992.
3. Klir G.J., and Bo, Yuan, "Fuzzy sets and fuzzy logic, Theory and applications", Prentice Hall, 1995.
4. Ethem Alpydin, "Introduction to Machine learning (Adaptive Computation and Machine Learning series)", MIT Press, 2004.

COURSE OUTCOMES (COs)

1. Be able to gain knowledge on various neural network architectures and training algorithms and summarize their merits and limitations.
2. Be able to select proper architecture, training algorithm, parameters of neural network for modeling and control of non-linear systems.
3. Be able to design and develop fuzzy logic controller for a given application.
4. Be able to apply Engineering fundamentals to use hybrid schemes and obtain solution for complex engineering problems.
5. Be able to formulate the optimization problem and able to simulate using selected optimization algorithms such as GA, PSO, SVM.
6. Be able to systematically carryout the process modeling and controller design using soft computing techniques using modern IT tool boxes for appropriate case studies.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO003.1	3	3	2	2	2	1	-	1	1	2	1	3	-	-	-

CO003.2	**3**	**3**	**3**	**3**	**2**	**1**	**-**	**1**	**1**	**2**	**1**	**3**	**1**	**3**	**3**
CO003.3	**3**	**3**	**2**	**2**	**3**	**1**	**-**	**1**	**1**	**2**	**1**	**3**	**2**	**3**	**3**
CO003.4	**3**	**3**	**3**	**3**	**3**	**1**	**-**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**3**
CO003.5	**2**	**2**	**2**	**3**	**3**	**1**	**-**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**3**
CO003.6	**3**	**2**	**3**	**3**	**3**	**1**	**-**	**1**	**1**	**2**	**1**	**3**	**3**	**3**	**3**
CO003	**2.8**	**2.6**	**2.5**	**2.6**	**2.6**	**1**	**-**	**1**	**1**	**2**	**1**	**3**	**2**	**3**	**3**

EI7004 **BIOMEDICAL INSTRUMENTATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES

- To make students understand various physiological signal measurements, Identification and classification.
- To make students understand various Biomedical Instruments used for Bio-potential measurement and non-electrical parameter measurement.
- To make students familiarized with the medical imaging and understanding the concept of assisting and therapeutic devices.

UNIT BASIC CONCEPTS OF MEDICAL INSTRUMENTATION 9

Terminology of medicine and medical devices – Generalized medical Instrumentation systems – Classification of Biomedical instruments – Medical measurement constraints – Interfering and modifying inputs – Compensation Techniques – Bio-statics – Design criteria – Transducers Selection criteria – The origin of Bio-potentials – Electrical activity of excitable cells – Volume conductor fields – Bio-potential Electrodes: The electrode-Electrolyte interface, Polarization: Polarizable and non-polarizable electrodes, Electrode behavior and circuit models, Electrode arrays, Surface and Microelectrodes.

UNIT II ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Types and Classification of biological signals – Electrical parameters acquisition: Origin, recording schemes and analysis of biomedical signals – ECG, EEG, EMG, ERG – Lead systems and recording methods – Typical waveforms – Noise and artifacts – Electrical safety in medical environment: Physiological Effect of Electrical Current, shock hazards – leakage current – Instruments for checking safety parameters of biomedical equipment.

UNIT III NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

Measurement of blood pressure – Cardiac output – Blood flow – Heart rate – Heart sound – Pulmonary function measurements – Spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analyzers, pH of blood – Measurement of blood pCO2, pO2,

finger-tip oximeter – ESR, GSR measurements.

UNIT IV MEDICAL IMAGING SYSTEMS 9

X-ray machine- Computer radiography – Computer tomography – Magnetic resonance imaging – Nuclear medicine – Single photo emission computer tomography – Positron emission tomography – Ultrasonography – Endoscopy – Thermal Imaging.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialyzers – Lithotripsy – Therapeutic and Prosthetic Devices – Infant Incubators – Drug Delivery Devices – Surgical Instruments.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, 4th Edition New York, 2009.
2. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.

REFERENCES:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 3rd Edition, New Delhi, 2014.
2. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", 2nd Edition, Boca Raton, CRC Press LLC, 2000.
3. Joseph J. Carr and John M. Brown," Introduction to Biomedical Equipment Technology", John Wiley and sons, 4th Edition, New York, 2000.
4. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., "Health Care Systems, Technology and Techniques", Springer, 1st Edition, 2011.
5. Duane Knudson," Fundamentals of Biomechanics", Springer, 2003.

COURSE OUTCOMES (COs)

1. Ability to compare and analyze the operation of different medical devices.
2. Ability to measure, detect and analyze the bio-signals.
3. Ability to select and apply the appropriate medical instruments for measurement.
4. Ability to design medical devices for diagnosis and therapeutic applications.
5. Ability to analyze simple bio-sensing and transduction problems.
6. Ability to apply safety standards and select disposal method and procedures for electrical diagnostic equipment.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO004.1	2	2	3	-	-	2	1	-	2	1	-	1	3	1	-
CO004.2	3	2	3	1	1	2	1	-	2	1	-	1	3	1	-
CO004.3	1	2	3	2	3	3	1	-	2	1	-	2	3	-	-
CO004.4	3	1	1	1	3	3	2	1	3	3	-	2	3	-	-
CO004.5	3	1	2	2	1	2	3	1	2	1	-	2	3	-	-
CO004.6	1	1	1	2	1	3	3	2	2	2	-	2	3	-	-
CO004	2.1	1.5	2.1	1.6	1.8	2.5	1.8	1.3	2.1	1.5	-	1.6	3	1	-

EI7005 FAULT DETECTION AND DIAGNOSIS LT P C
3 0 0 3

COURSE OBJECTIVES

1. To give an overview of different Fault Detection and Diagnosis methods.
2. To present an overview of various types of fault detection schemes using Limit Checking, Parameter estimation methods, Principle Component Analysis.
3. 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.
4. To impart knowledge and skills needed design and detect faults in sensor and actuators using GLR and MLR based Approaches.
5. 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:45 PERIODS

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, "FaultTolerant 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.

COURSE OUTCOMES (COs)

1. Ability to explain different approaches to Fault Detection and Diagnosis.
2. Ability detect and analysis faults using Limit Checking, Parameter estimation methods, Principle Component Analysis.
3. Ability to design and detect sensor and actuators faults using structured residual approach as well as directional structured residual approach.
4. Ability to design and detect faults in sensor and actuators using GLR and MLR based Approaches.
5. Ability to detect and quantify and compensate stiction in Control valves.

Attested

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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO005.1	3	3	2	3	2	1	-	1	1	2	1	3	2	-	1
CO005.2	2	3	2	3	2	1	-	1	1	2	1	3	2	-	1
CO005.3	2	2	3	3	2	1	-	1	1	2	1	3	2	-	1
CO005.4	2	2	3	3	2	1	-	1	1	2	1	3	2	-	1
CO005.5	2	2	3	3	2	1	-	1	1	2	1	3	2	-	1
CO005	2.2	2.4	2.6	3	2	1	-	1	1	2	1	3	2	-	1

EI7006 FIBRE OPTICS AND LASER INSTRUMENTATION L T P C
3 0 0 3

COURSE OBJECTIVES

1. To discuss about theory behind light propagation in optical fibers, types of optical fibers, dispersion characteristics for various types of optical fibers and attenuation measurement system.
2. To provide an overview of recent advances in fiber optic sensor technology.
3. To provide knowledge on principle of laser generation, laser system and its types.
4. To emphasize how lasers have been used for industrial applications.
5. To acquaint the students with fundamentals of holography.

UNIT I OPTICAL FIBER AND THEIR PROPERTIES 9

Principles of light propagation through a fiber – laws related to light propagation through fiber – Different types of fiber and their properties, Fiber manufacture – mechanical and transmission characteristics – Connectors & splicers – Fiber termination – Optical sources – Optical detectors.

UNIT II INDUSTRIAL APPLICATION OF OPTICALFIBER 9

Fiber optic sensors – Fiber optic instrumentation system for measurement of fiber characteristics – Different types of modulators – Interferometric method for measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain – fiber optic gyroscope – Polarization Maintaining fibers.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers, Excimer lasers, VCSEL .

Attested

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

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Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Material Removal and vaporization.

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS 9

Holography – Basic principle – Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components – Medical applications of lasers – laser and tissue interaction – Laser instruments for surgery – removal of tumours of vocal cards, brain surgery, plastic surgery, gynecology and oncology.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Keiser, G., "Optical Fiber Communication", McGraw-Hill, 3rd Edition, 2000.
2. Eric Udd, William B., and Spillman, Jr., "Fiber Optic Sensors: An Introduction for Engineers and Scientists ", John Wiley & Sons, 2011.

REFERENCES:

1. John and Harry, "Industrial lasers and their application", McGraw-Hill, 2002.
2. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.
3. Monte Ross, "Laser Applications", McGraw-Hill, 1968.
4. NPTEL lecture on "Advanced optical communication" by R.K. Shevgaonkar, IIT Bombay.

COURSE OUTCOMES (COs):

1. Ability to utilize the principles of light transmission, characteristics and losses in optical fibers for measurement applications.
2. Ability to apply the concepts of optical fibers for its use in sensor development as well as important applications in production, manufacturing and industrial applications.
3. Ability to compare the lasing theory of various laser generation systems.
4. Ability to design laser systems for measurement of physical quantities and for industrial applications.
5. Ability to select lasers for a specific Industrial and medical application.
6. Ability to apply the principles of lasers for creating new sensors and measurement systems.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO006.1	3	1	-	-			-	-	-	-	-	-	-	-	-
CO006.2	3	1	1	-			-	-	2	-	-	1	-	-	-
CO006.3	3	-	-	-	1		-	-	-	-	-	-	-	-	-
CO006.4	3	-	-	-	2		-	-	2	-	-	2	-	-	-
CO006.5	3	-	1	-	2		-	-	2	-	-	-	-	-	-
CO006.6	3	-	-	-	2	1	-	-	2	-	-	1	1	-	-
CO006	3	1	1	-	1.6	1	-	-	2	-	-	1.3	1	-	-

EI7007 FUNDAMENTALS OF NANO SCIENCE AND MEMS LT P C
3 0 0 3

COURSE OBJECTIVES

1. To provide wide information dealing with nano material and its necessity.
2. To understand the impact of various steps needed to be followed in nano material preparation.
3. To analyze methods involving preparation of nano scale devices.
4. To provide knowledge about working nature and neighborhood condition regarding the preparation.
5. To Explore the properties of various types of nano materials.

UNIT I INTRODUCTION 9

Nano scale Science and Technology – Implications for Physics, Chemistry, Biology and Engineering – Classifications of nano structured materials – nano particles – quantum dots, Nano wires – ultrathin films – multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II PREPARATION METHODS 9

Bottom-up Synthesis – Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Selfassembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 9

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography.

UNIT IV PREPARATION ENVIRONMENTS 9

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

UNIT V CHARECTERISATION 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.

TOTAL : 45 PERIODS

Attested

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TEXT BOOKS:

1. Mickwilson et al, "Nano Technology: Basic science and Emerging Technologies", Chapman & Hall/CRC Press, 2004.
2. Jeremy J.Ramsden, "Nano Technology: an Introduction", Elsevier Publication, 2011. 109

REFERENCES:

1. Edelstein, A.S., and Cammearata, R.C., eds., "Nano materials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. John Dinardo, N., "Nano scale characterization of surfaces & Interfaces", 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000.
3. Timp, G., (Editor), "Nanotechnology", AIP press/Springer, 1999.
4. Akhlesh Lakhtakia (Editor), "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.

COURSE OUTCOMES (COs)

1. Ability to utilize the principles of nano science along with the properties of nano materials for the design of novel systems.
2. Ability to select and apply the various techniques for synthesis of nano materials for specified application.
3. Ability to select and apply the various patterning techniques for development of micro and nano scale devices.
4. Ability to analyze the toxic effects of nano materials along with the safety measures for nano technological research.
5. Ability to apply and utilize the instrumentation systems for characterization of nano materials.
6. Will be in a position to learn and keep in pace with recent nanotechnological advancements.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO007.1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO007.2	3	-	-	-	1	-	-	-	1	-	-	1	-	-	-
CO007.3	3	-	1	-	1	-	-	-	1	-	-	1	-	2	-
CO007.4	3	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO007.5	3	-	-	-	1	-	-	-	1	-	-	1	-	-	-
CO007.6	3	2	-	-	-	-	-	-	-	-	-	1	1	-	-
CO007	3	1.5	1	-	1	-	-	-	-	-	-	1	1	2	-

EI7008 INSTRUMENTATION IN PETROCHEMICAL INDUSTRY LT 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

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

Attested

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. Havard Devold, "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.

COURSE OUTCOMES (COs)

1. Gain knowledge on oil gas production process and important unit operations in a refinery
2. Having gained the process knowledge, ability to develop and analyze the process description of selective processes.
3. Able to develop, analyze and select appropriate control strategy for selective unit operations in a refinery.
4. Able to analyze the effect of important process variables which are having effect on yield.
5. Able to understand the onshore and off-shore extraction methods used for extracting crude.
6. Able to classify the hazardous zones for industrial scenario with industrial safety standards.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO008.1	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO008.2	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO008.3	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO008.4	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO008.5	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO008.6	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO008	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-

EI7009	INSTRUMENTATION STANDARDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. 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 II 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. 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

TEXT BOOKS:

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

COURSE OUTCOMES (COs)

1. Ability to understand the role of standards organization.
2. Ability to implement different standards related to installation and control system, programming, documentation, equipment in hazardous area and instrument specification forms.
3. Ability to utilize the different standards related to control valve and actuators.
4. Ability to implement standards related to power plant and nuclear power plant.
5. Ability to select different standards related to orifice sizing, RTD and thermocouples.
6. Ability to compare and select standards related to Process industries.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO009.1	2	-	-	-	-	1	1	-	-	2	-	-	2	2	2
CO009.2	-	-	-	-	-	-	-	2	2	-	-	-	2	2	2
CO009.3	-	-	-	-	1	2	-	-	-	-	-	-	2	2	2
CO009.4	-	-	-	1	1	-	2	-	-	-	-	-	-	-	-
CO009.5	-	-	1	-	-	-	-	-	-	-	-	-	2	2	-
CO009.6	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-
CO009	2	1	1	1	1	1.5	1.5	2	2	2	-	-	2	2	2

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EI7010 MICRO CONTROLLER BASED SYSTEM DESIGN LT P C
3 0 0 3

COURSE OBJECTIVES

1. To impart knowledge on PIC microcontroller and ARM processor.
2. To introduce the architecture and instruction set of PIC 16F87x.
3. To make them familiar with ports, timer, CCP modules, interrupts, peripherals and
4. interfacing of PIC 16F87x.
5. To introduce the architecture and assembly language programming of ARM LPC 2148.
6. To make them learn the ARM organization and instruction set.

UNIT I P IC INTRODUCTION 9

Introduction to PIC Microcontroller – PIC 16F87x Architecture –Instruction Set – Simple Operations.

UNIT II PORTS, COUNTERS, TIMER, CCP MODULE AND INTERRUPTS 9

PIC16F87I2C I/O Ports, Counters, Timers CCP Modules –Interrupts.

UNIT III PERIPHERALS AND INTERFACING 9

16F87xI2C Bus Peripherals Chip Access – Analog to Digital Converter – UART.

UNIT IV ARM LPC2148 INTRODUCTION 9

ARM LPC2148 Architecture – ARM LPC2148 Development tools – ARM Assembly Languages Programming – Simple Examples.

UNIT V ARM LPC2148 ORGANIZATION 9

3-Stage Pipeline ARM Organization – 5-Stage Pipeline ARM Organization – ARM Implementation – ARM Instruction Set.

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Peatman, J.B., “Design with PIC Micro Controllers”, Pearson Education, 3rd Edition, 2004.
2. Furber, S., “ARM System on Chip Architecture”, Addison Wesley trade Computer Publication, 2000.

REFERENCES:

1. Andrew N. Sloss, Dominic Symes and Chris Wright, “ARM System Developer’s Guide: Designing and Optimizing System Software”, Elsevier Inc., 2013.
2. Trevor Martin, “The insider’s guide to the Philips ARM 7 – based Microcontrollers: An Engineers Introduction to the LPC 2100 Series” Hitex (UK) Ltd., 2005.
3. Muhammed Ali Mazidi, RolinMckinlay and Danny Causey, “PIC Microcontroller and Embedded Systems using Assembly and C for PIC18”, Prentice Hall Publications, 2007.
4. Martin Bates, “Interfacing PIC Microcontrollers-Embedded Design by interactive

simulation", Newnes Publication, 2006.
5. Tim Wilmshurst, "Designing Embedded Systems with PIC Microcontrollers – Principles and Applications", Newnes Publication, 2007.
6. Julio Sanchez Maria P. Canton, "Microcontroller Programming: The microchip PIC", CRC Press, Taylor & Francis Group, 2007.

COURSE OUTCOMES:

1. Ability to understand the concept of embedded system and its architectural features.
2. Ability to provide suitable software solutions for embedded applications.
3. Ability to configure and utilize the services of various peripheral devices associated with microprocessors and microcontrollers.
4. Ability to analyze the requirements of a given application and use appropriate communication protocols.
5. Ability to recognize the nuances of various microcontrollers and provide embedded solution with the right choice of microcontroller and the associated peripherals for a given application.
6. Ability to effectively utilize the available resources towards the design and development of embedded systems for real world problems

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO010.1	3	2	2	3	2	-	-	1	1	2	1	3	1	1	1
CO010.2	3	3	3	3	3	-	1	1	1	2	1	3	1	1	1
CO010.3	3	2	2	2	2	-	1	1	1	2	1	3	1	1	1
CO010.4	3	3	2	3	2	-		1	1	2	1	3	1	1	1
CO010.5	3	3	3	3	3	2	2	1	1	2	1	3	1	1	1
CO010.6	3	3	3	3	3	2	1	1	1	2	1	3	1	1	1
CO010	3	2.6	2.5	2.8	2.5	2	1.2	1	1	2	1	3	1	1	1

EI7011 MODEL PREDICTIVE CONTROL LT P C
3 0 0 3

COURSE OBJECTIVES

1. To teach the students the general principles of model predictive control scheme.
2. 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.
3. To highlight the key features of MPC for its Industrial Success.
4. To introduce the skills required to formulate both unconstrained and constrained optimal

control schemes.

5. 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 – MultipleModel based Model Predictive Control Scheme - Fast Methods for Implementing Nonlinear Model Predictive Control Scheme – Case Studies

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

1. Ability to explain the advantages and disadvantages of various MPC schemes.
2. Ability to design both unconstrained and constrained model predictive controllers.
3. Ability to explain the advanced Features supported by the MPC Scheme.
4. Ability to Identify, formulate and solve problem in the field of Process Control domain using MPC.
5. 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

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO011.1	2	3	2	2	3	1	-	1	1	2	1	3	**2**	-	3
CO011.2	2	2	3	3	2	1	-	1	1	2	1	3	**2**	-	3
CO011.3	2	3	3	3	2	1	-	1	1	2	1	3	**2**	-	3
CO011.4	2	3	2	2	3	1	-	1	1	2	1	2	**2**	-	3
CO011.5	2	2	3	2	2	1	-	1	1	2	1	2	**2**	-	3
CO011	**2**	**2.6**	**2.6**	**2.4**	**2.4**	**1**	**-**	**1**	**1**	**2**	**1**	**2.6**	**2**	**-**	**3**

EI7012 NON-LINEAR CONTROL SYSTEMS LT P C
3 0 0 3

COURSE OBJECTIVES

1. To understand the nature of non-linear systems and to analyze the stability of such systems
2. To develop suitable models of non-linear systems and to develop suitable controllers for such systems
3. To understand the chaotic and bifurcation behavior of non-linear systems
4. 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(COs)

1. Ability to apply mathematical knowledge and basics of science and engineering to develop model for non-linear system.
2. Ability to analyze non-linear system based on the first principle model.
3. Ability to come out the solution for complex non-linear system.
4. Ability to develop various control schemes for non-linear systems.
5. 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. 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.

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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO012.1	3	2	2	2	2	1	-	1	1	2	1	3	-	-	3
CO012.2	2	3	2	2	2	1	-	1	1	2	1	3	-	-	3
CO012.3	2	2	3	2	2	1	-	1	1	2	1	3	-	-	-
CO012.4	2	2	3	3	2	1	-	1	1	2	1	3	-	-	3
CO012.5	2	2	3	2	2	1	-	1	1	2	1	3	-	-	3
CO012	2.2	2.2	2.6	2.2	2	1	-	1	1	2	1	3	-	-	3

EI7013 NUCLEAR POWER PLANT INSTRUMENTATION L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce students to the fundamentals of nuclear power reactor.
2. The construction and principle of operation of the different sensing and indicating devices used at nuclear power plants will be explained to students.
3. To study about the various types of Nuclear power Reactor.
4. To characterize radioactive wastes based on the analysis of radioactive waste generation.
5. To elaborate different types of control schemes involved in nuclear power plant.

UNIT I FUNDAMENTAL CONSIDERATIONS IN NUCLEAR POWER REACTOR 9

Nuclear and Fossil Fuels, Definitions: Nuclear Terms, Fission Process Terms, Nuclear Reactor Terms, Nuclear Reactor Kinetics: Point Kinetics without delayed neutrons – Point Kinetics with delayed neutrons, Reactivity, Inhour equation, Effects of reactivity Insertions, Reactivity changes –Three Dimensional Kinetics.

UNIT II MEASURING INSTRUMENTS AND ANALYZER IN NUCLEAR POWER PLANT 9

Nuclear Radiation Sensors – Out-of-Core – Neutron Sensors – In-Core – Process I and Position Sensing, Steam Properties Sensing, Water Properties Sensing, Gas Properties Sensing – Special sensor for Sodium cooled reactors and gas cooled reactors.

UNIT III TYPES OF NUCLEAR POWER REACTOR 9

Pressurized Water Reactor – Boiling Water Reactor – Pressurized Heavy Water Reactor – Sodium Cooled Fast Reactor – Advanced Gas Cooled Reactor .

instrumentation: Temperature Sensing, Pressure Sensing and transmitting, Flow Sensing, Level

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UNIT IV NUCLEAR WASTE DISPOSAL AND REACTOR SAFETY 9

Types of Radioactive Wastes : Exempt waste and very low level waste, Low level waste, Intermediate Level waste, High level waste – Treatment and conditioning of Nuclear waste - Waste Disposal Methods, Nuclear Reactor Safety: Introduction, Accident Prevention, Engineered safety features, Abnormal Event Analysis – Licensing design basis Evaluation.

UNIT V MODELING AND CONTROL OF NUCLEAR POWER REACTOR 9

Multipoint Kinetics modeling of Large reactors: Introduction, Derivation of Multipoint Kinetics model, Selection of suitable nodalization scheme, Application to the AHWR Thermal hydraulics model, Coupled Neutronics –Thermal Hydraulics model – Reactor Stability Analysis – Control of Nuclear Power: General features of Reactor control, Methods of control, control loops , Effectiveness of control rods, Output Feedback control design - Direct block diagonalization and composite control of Three time scale systems – Design of Fast output sampling controller for Three time scale systems.

TOTAL : 45 PERIODS

Course Outcomes

1. Be able to recognize and recall the basics of nuclear reactor terminology, definitions, and concepts associated with nuclear reactor physics.
2. Be able to understand and select appropriate instrument from the types of radiation measurement equipment and nuclear power plant instrumentation.
3. Be able to identify and summarize the specific features of different types of nuclear reactors.
4. Be able to understand the role and responsibility of effective nuclear waste disposal.
5. Be able to apply their mathematical knowledge and engineering principles to model the nuclear reactor and able to control the reactor.
6. Be able to carry out necessary simulation of models of different types of Nuclear reactors and design appropriate controllers using modern IT tools

TEXT BOOKS:

1. Joseph M. Harrer and James G. Beckerly, “Nuclear Power Reactor Instrumentation Systems Handbook”, Office of Information Services, U.S. Atomic Energy Commission, 1973.

2. Samuel Glasstone and Alexander Sessonske, ”Nuclear Reactor Engineering”, CBS publishers and Distributors Pvt. Ltd., 2004.

REFERENCES:

1. Shimjith, S.R., Tawari A.P., and Bandyopathy, B. “Modeling and Control of a Large Nuclear reactor”, BARC Mumbai, India.

2. Yoshiaki Oka and Katsuo Suzuki, “Nuclear Reactor Kinetics and Plant Control”, An Advanced Course in Nuclear Engineering, Springer Japan.

3. James J. Duderstadt and Louis J. Hamilton, "Nuclear Reactor Analysis" Wiley, 1st Edition, 1976.
4. NPTEL Video Lectures on "Nuclear Reactors and Safety - An Introduction" by Dr. G. Vaidyanathan.
5. NPTEL Video Lectures on "Nuclear Science & Engineering" by Dr. Santanu Ghosh.
6. NPTEL Video Lectures on "Nuclear Reactor Technology" by Dr. K.S. Rajan.
7. NPTEL Video Lectures on "Nuclear Physics: Fundamentals and Applications" by Prof. H.C. Verma

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO013.1	3	3	2	2	1	1	-	1	1	1	1	3	-	-	-
CO013.2	3	3	3	3	1	1	2	1	1	1	1	3	2	3	1
CO013.3	3	3	3	2	1	1	2	1	1	1	1	3	1	3	2
CO013.4	3	3	3	1	1	1	3	1	1	1	1	3	-	-	-
CO013.5	3	3	3	3	1	1	2	1	1	1	1	3	2	3	3
CO013.6	3	3	3	3	1	1	2	1	1	1	1	3	1	3	3
CO013	3	3	2.83	2.33	1	1	1.83	1	1	1	1	3	1.5	3	2.2

EI7014 OPTIMAL CONTROL LT P C
3 0 0 3

COURSE OBJECTIVES

1. To impart knowledge and skills needed to design Linear Quadratic Regulator for Timeinvariant and Time-varying Linear system (Continuous time and Discrete-time systems)
2. To introduce concepts needed to design optimal controller using Dynamic Programming Approach and H-J-B equation.
3. To introduce concepts needed to design optimal controller in the presence of state constraints and time optimal controller.
4. To give exposure to different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.

UNIT I CALCULUS OF VARIATIONS AND OPTIMAL CONTROL 9

Introduction – Performance Index- Constraints – Formal statement of optimal control system – Calculus of variations – Function, Functional, Increment, Differential and variation and optimum of function and functional – The basic variational problem Extreme of functions and functional with conditions – variational approach to optimal control system.

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UNIT II LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM 9

Problem formulation – Finite time Linear Quadratic regulator – Infinite time LQR system: Time Varying case - Time-invariant case – Stability issues of Time-invariant regulator – Linear Quadratic Tracking system: Fine time case and Infinite time case.

UNIT III DISCRETE TIME OPTIMAL CONTROL SYSTEMS 9

Variational calculus for Discrete time systems – Discrete time optimal control systems: Fixed-final state and open-loop optimal control and Free-final state and open-loop optimal control - Discrete time linear state regulator system – Steady state regulator system.

UNIT IV PONTRYAGIN MINIMUM PRINCIPLE & DYNAMIC PROGRAMMING 9

Pontryagin Minimum Principle – Dynamic Programming: Principle of optimality, optimal control using Dynamic Programming – Optimal Control of Continuous time and Discrete-time systems – Hamilton-Jacobi-Bellman Equation – LQR system using H-J-B equation.

UNIT V CONSTRAINED OPTIMAL CONTROL SYSTEMS 9

Time optimal control systems – Fuel Optimal Control Systems – Energy Optimal Control Systems – Optimal Control Systems with State Constraints.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to apply mathematical knowledge to develop optimal control scheme
2. Ability to design Linear Quadratic Regulator for Time-invariant and Time-varying linear system (Continuous time and Discrete-time systems).
3. Ability to design optimal controller using Dynamic Programming Approach and H-J-B equation.
4. Ability to design optimal controller in the presence of state constraints.
5. Ability to solve different type of optimal control problems such as time-optimal, fuel optimal and energy optimal control problems.

TEXT BOOKS:

1. Kirk, D. E., “Optimal Control Theory – An Introduction”, Dover Publications, Inc. Mineola, New York, 2012.
2. Subbaram Naidu, D., “Optimal Control Systems”, CRC Press, New York, 2003.

REFERENCES:

1. Lewis, F.L., Draguna Vrabie, and Syrmos, V.L., “Optimal Control”, 3rd Edition, Wiley Publication, 2012.
2. Stengel, R. F., “Optimal Control and Estimation”, Dover Publications, Inc., Newyork, 1994.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO014.1	2	3	2	3	2	1	-	1	1	2	1	3	-	-	3
CO014.2	3	2	2	3	2	1	-	1	1	2	1	3	-	-	3
CO014.3	2	2	3	3	2	1	-	1	1	2	1	3	-	-	3
CO014.4	2	2	3	3	2	1	-	1	1	2	1	3	-	-	3
CO014.5	2	2	3	3	2	1	-	1	1	2	1	3	-	-	3
CO014	**2.2**	**2.2**	**2.6**	**3**	**2**	**1**	**-**	**1**	**1**	**2**	**1**	**3**	**-**	**-**	**3**

EI7015 POWER ELECTRONICS, DRIVES AND CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES

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

UNIT I POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS 9

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

UNIT II CONTROLLED RECTIFIERS AND AC CONTROLLERS 9

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

UNIT III DC TO DC CONVERTERS 9

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

UNIT IV INVERTERS 9

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

UNIT V DRIVES AND CONTROL 9

Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and

chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only) – Introduction to vector control of AC drives.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to explain various devices and their structure, operating characteristics in the field Of electronics.
2. Ability to classify, analyze and design, Controlled rectifier and AC Controllers.
3. Ability to analyze and design of DC to DC and DC to AC converters.
4. Ability to apply power electronic circuits for the control of electric drive applications.
5. Ability to exposure to design and analyze power electronic circuits using simulation software.

TEXT BOOKS:

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

REFERENCES:

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO015.1	1	2	2	1	2	-	-	-	-	-	1	1	-	**1**	-
CO015.2	2	2	2	1	2	-	-	-	-	-	1	2	-	**1**	1
CO015.3	1	2	3	1	2	-	-	-	-	-	1	2	-	**1**	1
CO015.4	3	2	3	2	2	-	-	-	-	-	1	2	-	**1**	2
CO015.5	1	1	3	1	3	-	-	-	-	-	1	2	-	**1**	2
CO015	**1.8**	**1.8**	**2.6**	**1.2**	**1.8**	**-**	**-**	**-**	**-**	**-**	**1**	**1.8**	**-**	**1**	**1.5**

EI7016	SAFETY INSTRUMENTED SYSTEM	L T P C
		3 0 3 3

COURSE OBJECTIVES

1. To make the students aware of basic concepts of safety instrumented system, standards and risk analysis techniques.
2. To make the students understand different layers of protection.
3. To make students conscious about safety instrumentation applications.

UNIT I INTRODUCTION 9

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

UNIT II PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS 9

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

UNIT III SAFETY INTEGRITY LEVEL (SIL) 9

Evaluating Risk, Safety Integrity Levels, SIL Determination Method : As Low As Reasonably Practical (ALARP), Risk matrix, Risk Graph, Layers Of Protection Analysis (LOPA) – Issues related to system size and complexity –Issues related to field device safety – Functional Testing.

UNIT IV SYSTEM EVALUATION 9

Failure Modes, Safe/Dangerous Failures, Detected/Undetected Failures, Metrics: Failure Rate, MTBF, and Life, Degree of Modeling Accuracy, Modeling 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

COURSE OUTCOMES (COs)

1. Ability to analyse the role of safety instrumented system in the industry.
2. Ability to Identify and analyse the hazards.
3. Ability to determine the safety integrity level for an application.
4. Ability to characterize the safety environment in industry.
5. Ability to analyse the failure modes, failure rates and MTBF using various reliability engineering tools.
6. Ability to apply the design, installation and maintenance procedures for SIS applied to industrial processes.
7. 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, 2006.
2. Eric W. Scharpf, Heidi J. Hartmann, Harlod W. Thomas, "Practical SIL target selection: Risk analysis per the IEC 61511 safety Lifecycle", Exida, 2012.

REFERENCES:

1. William M. Goble and Harry Cheddie, "Safety Instrumented Systems Verification: Practical Probabilistic Calculations" ISA, 2005.
2. Edward Marszal, Eric W. Scharpf, "Safety Integrity Level Selection: Systematic Methods Including Layer of Protection Analysis", ISA, 2002.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO016.1	2	1	2		1				1	2			1	1	2
CO016.2	1	1					1			1			1	2	1
CO016.3	3	1	1	1									1	1	2
CO016.4					1	1	1						2	2	3
CO016.5		1	1	1									1	1	2
CO016.6	3	1	1	3	1								1	1	
CO016.7										1	3	3	3	2	
CO016	1.2	1	1.2	1.2	1	1	1	-	1	1.3	3	3	1.4	1.4	2

EI7017 STATE AND PARAMETER ESTIMATION LT P C
3 0 0 3

COURSE OBJECTIVES

1. To elaborate the concept of estimating the state variables of a system using state estimation algorithms.
2. To elaborate the concept of estimating the parameters of the Input-output models using parameter estimation algorithms.
3. To make the student understand the various closed loop system identification techniques.
4. To make the students understand the use of ANN, Fuzzy Logic, ANFIS for modeling of nonlinear system and to get familiarized with the ANN and Fuzzy Logic tool boxes.
5. To provide the background on the practical aspects of conducting experiments for real time system identification.

UNIT I KALMAN UPDATE BASED FILTERS & PARTICLE FILTER 9

Review of Matrix Algebra and Matrix Calculus and Probability Theory – Least Square Estimation – Kalman filter – Extended Kalman filter – Unscented Kalman filter – Ensemble Kalman filter – Particle filter.

UNIT II PARAMETER ESTIMATION METHODS 9

Parametric model structures: ARX, ARMAX, OE, BJ models - Least squares method, Weighted Least Squares, Maximum Likelihood Estimation and Prediction error methods. Recursive Estimation methods – Simultaneous State and Parameter Estimation – Dual State and Parameter Estimation.

UNIT III CLOSED- LOOP IDENTIFICATION 9

Identification of systems operating in closed loop: direct identification and indirect identification – Subspace Identification methods: classical and innovation forms – Relay feedback identification of stable processes.

UNIT IV NONLINEAR SYSTEM IDENTIFICATION 9

Modeling of non linear systems using ANN- NARX & NARMAX - Training Feed-forward and Recurrent Neural Networks – TSK model – Adaptive Neuro-Fuzzy Inference System (ANFIS) - Introduction to Support Vector Regression.

UNIT V PRACTICAL ASPECTS OF IDENTIFICATION 9

Practical aspects: experimental design – input design for identification, notion for persistent excitation, drifts and de-trending – outliers and missing data – pre-filtering – robustness – Model validation and Model structure determination – Case studies.

TOTAL : 45 PERIODS

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COURSE OUTCOMES (COs)

1. Ability to design and implement state estimation schemes.
2. Ability to develop various models (Linear & Nonlinear) from the experimental data.
3. Be able to select a suitable model and parameter estimation algorithm for the identification of systems.
4. Be able to carry out the verification and validation of identified model.
5. Will gain expertise on using the model for prediction and simulation purposes and for developing suitable control schemes.

TEXT BOOKS:

1. Dan Simon, "Optimal State Estimation Kalman, H-infinity and Non-linear Approaches", John Wiley and Sons, 2006.
2. Lennart Ljung, "System Identification: Theory for the user", 2nd Edition, Prentice Hall, 1999.
3. Tangirala, A.K., "Principles of System Identification: Theory and Practice", CRC Press, 2014.

REFERENCES:

1. Van der Heijden, F., Duin, R.P.W., De Ridder, D., and Tax, D.M.J., "Classification, Parameter Estimation and State Estimation", An Engineering Approach Using MATLAB, John Wiley & Sons Ltd., 2004.
2. Miller, W.T., Sutton, R.S., and Webrose, P.J., "Neural Networks for Control", MIT Press, 1996.
3. Cortes, C., and Vapnik, V., "Support-Vector Networks, Machine Learning", 1995.
4. Karel J. Keesman, "System Identification an Introduction", Springer, 2011.
5. Tao Liu and Furong Gao, "Industrial Process Identification and control design, Step-test and relay-experiment-based methods", Springer- Verlag London Ltd., 2012.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO017.1	2	2	3	2	2	1	-	1	1	2	1	3	**2**	-	3
CO017.2	3	2	2	3	2	1	-	1	1	2	1	3	**2**	-	3
CO017.3	2	2	3	3	2	1	-	1	1	2	1	3	**2**	-	3
CO017.4	2	2	2	2	3	1	-	1	1	2	1	2	**2**	-	3
CO017.5	2	3	2	2	2	1	-	1	1	2	1	2	**2**	-	3
CO017	**2.2**	**2.2**	**2.4**	**2.4**	**2.2**	**1**	**-**	**1**	**1**	**2**	**1**	**2.6**	**2**	**-**	**3**

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EI7018 THERMAL POWER PLANT INSTRUMENTATION LT P C
3 0 0 3

COURSE OBJECTIVES

1. Gain knowledge on different types of power plants.
2. Study about the important process variables and their measurements.
3. To understand the important control loops involved in thermal power plants.
4. To analyze the various parameters related to steam turbines**.**

UNIT I OVERVIEW OF POWER GENERATION 9

Survey of methods of power generation – hydro, thermal, nuclear, solar and wind power – Importance of instrumentation in power generation – Thermal power plant – Building blocks – Combined Cycle System – Combined Heat and Power System – sub critical and supercritical boilers.

UNIT II MEASUREMENTS IN POWER PLANTS 9

Measurement of feed water flow, air flow, steam flow and coal flow – Drum level measurement– Steam pressure and temperature measurement – Turbine speed and vibration measurement – Flue gas analyzer – Fuel composition analyzer.

UNIT III BOILER CONTROL – I 9

Combustion of fuel and excess air – Firing rate demand – Steam temperature control – Control of deaerator – Drum level control: Single, two and three element control – Furnace draft control – implosion and explosion – flue gas dew point control – Trimming of combustion air – Soot blowing.

UNIT IV BOILER CONTROL – II 9

Burners for liquid and solid fuels – Burner management – Furnace safety interlocks – Coal pulverizer control – Combustion control for liquid and solid fuel fired boilers – air/fuel ratio control– fluidized bed boiler – Cyclone furnace.

UNIT V TURBINE MONITORING AND CONTROL 9

Types of steam turbines – impulse and reaction turbines – compounding – Turbine governing system– Speed and Load control – Transient speed rise – Free governor mode operation – Automatic Load Frequency Control – Turbine oil system – Oil pressure drop relay – Oil cooling system– Turbine run up system.

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

1. Able to understand and analyze the process diagram of hydral, thermal, nuclear, wind and solar power plants.
2. Will be in a position to select instruments for monitoring various parameters related to thermal power plant.
3. Able to under stand the role of various systems present in thermal power plant.
4. Able to Evaluate the appropriate control strategy for control of boiler drum level, superheater and deaerator.
5. Acquire knowledge on combustion control of coal fired boilers and control of steam turbines and associated turbine systems.

TEXT BOOKS:

1. Sam Dukelow, "Control of Boilers", Instrument Society of America, 1991.
2. Gill, A.B., "Power Plant performance", Butterworth and Co (Publishers) Ltd, 2003.

REFERENCES:

1. Krishnaswamy, K. and Ponnibala, M., "Power Plant Instrumentation", PHI Learning Pvt. Ltd.,

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO018.1	3	1	3	1	-	2	2	1	-	1	-	-	2	-	-
CO018.2	3	-	3	1	-	2	-	1	-	1	-	-	2	-	-
CO018.3	3	-	3	1	1	2	2	1	-	1	-	-	2	-	-
CO018.4	3	-	3	1	-	2	2	1	-	1	-	-	2	-	-
CO018.5	3	-	3	1	1	2	2	1	-	1	-	-	2	-	-
CO018	3	1	3	1	2	2	2	1	-	1	-	-	2	-	-

EI7019 UNIT OPERATIONS AND CONTROL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

1. Study the unit operations involved for transportation, mixing and separation of solids.
2. Study the unit operations involved for transportation, mixing and separation of fluids.
3. Understand the basic operations involved with heat exchangers, Distillation and chemical reactions.
4. Gain knowledge about the operations of evaporators and crystallizers, drying and cooling towers.
5. Gain knowledge on the operation of dryers, distillation column, refrigerators and chemical reactors.

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UNIT I MECHANICAL OPERATIONS- I 9

OPERATIONS ON SOLIDS: General Characteristics of solids, Storage and conveying of solids: bunkers, silos, bins and hoppers, transport of solids in bulk, conveyor selection, different types of conveyors. Estimation of particle size - Screening methods and equipment. Adjusting particle size: methods of size reduction, classification of equipment, crushers, grinders. size enlargement- Principle of granulation, briquetting, pelletisation and flocculation. Mixing: mixing of powders. Separation: Electrostatic and magnetic separators, applications.

UNIT II MECHANICAL OPERATIONS-II 9

OPERATIONS ON FLUIDS: Transport of fluids, Mixing and agitation: Mixing of liquids, selection of suitable mixers. Separation: Gravity settling, sedimentation, thickening, double cone classifier, centrifugal separation. Cyclones - Operation, equipment, control and applications.

UNIT III HEAT TRANSFER- I AND ITS APPLICATIONS 9

Heat exchangers: Single pass and multi pass heat exchangers, condensers, reboilers Combustion process in thermal power plant, Distillation: Binary distillation, Batch distillation, controls and operations, Chemical reactors.

UNIT IV HEAT TRANSFER- II 9

Theory of evaporation – single effect and multiple effect evaporators – Crystallization – nucleation and growth – classification of crystallizers. Drying: classification of Dryers, batch and continuous dryers, dryers for solids and slurries and cooling Towers, Refrigeration.

UNIT V CASE STUDY 9

Unit Operations and Control schemes applied to Thermal Power plant, Steel Industry, Paper and Pulp Industry, Leather Industry.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Apply the knowledge on solids & fluids to handle the raw materials.
2. Select and apply relevant handling techniques to convert the solids and fluids for specific applications.
3. Come out with solutions for simple/complex problems in heat transfer and design the heat exchange equipment for different applications such as distillation, boilers.
4. Able to carry out multidisciplinary projects using heat transfer, mass transfer concepts.
5. Gain ability for lifelong learning of new techniques and developments in various types of unit operations in industries.

TEXT BOOKS:

1. Balchen ,J.G., and Mumme, K.J., " Process Control structures and applications", Van Nostrand Reinhold Co., New York, 1988.
2. Warren L. McCabe, Julian C. Smith and Peter Harriot, "Unit Operations of Chemical

Engineering", McGraw-Hill International Edition, New York, Sixth Edition, 2001.
3. James R.couper, Roy Penny, W., James R.Fair and Stanley M.Walas, "Chemical Process Equipment :Selection and Design", Gulf Professional Publishing, 2010.

REFERENCES:

1. Waddams, A.L., "Chemicals from petroleum", Butler and Taner Ltd., UK, 1968.
2. Liptak, B.G., "Process measurement and analysis", Chilton Book Company, USA, 1995.
3. Luyben W.C., "Process Modeling, Simulation and Control for Chemical Engineers", McGraw-Hill International edition, USA, 1989.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO019.1	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO019.2	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO019.3	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO019.4	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO019.5	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-
CO019	3	1	1	-	2	2	1	1	-	1	-	-	2	-	-

EI7071 INDUSTRIAL DATA COMMUNICATION LT P C

3 0 0 3

COURSE OBJECTIVES

1. To give an overview of the Industrial data communications systems.
2. To provide a fundamental understanding of common principles, various standards, protocols.
3. To provide insight into some of the new principles those are evolving for future networks.

UNIT I DATA NETWORK FUNDAMENTALS 9

EIA 232 interface standard – EIA 485 interface standard – ISO/OSI Reference model – Media access protocol: Command/response, Token passing and CSMA/CD – TCP/IP – Bridges – Routers – Gateways – Standard ETHERNET Configuration

UNIT II MODBUS AND HART 9

MODBUS: protocol structure, Function codes. Evolution of signal standard: HART communication protocol – Communication modes – HART Networks – HART commands – HART applications – Troubleshooting

UNIT III PROFIBUS AND FF 9

Fieldbus: Introduction – General Fieldbus architecture – Basic requirements of Fieldbus standard – Fieldbus topology – Interoperability and Interchangeability. Profibus: Introduction – Profibus protocol stack – Profibus communication model – Communication objects – Foundation field bus versus Profibus.

UNIT IV AS – INTERFACE (AS-i), DEVICENET AND INDUSTRIAL ETHERNET 9

AS interface: Introduction – Physical layer – Data link layer – Operating characteristics. Device net: Introduction – Physical layer – Data link layer and Application layer.
Industrial Ethernet: Introduction – 10Mbps Ethernet – 100Mbps Ethernet.

UNIT V WIRELESS COMMUNICATION 9

Wireless sensor networks: Hardware components – energy consumption of sensor nodes – Network architecture – sensor network scenario. Wireless HART – Existing Wireless Options: IEEE 802.15.4 - ISA 100 – Zigbee – Bluetooth – their relevance to industrial applications

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

1. Be able to gain knowledge on various Industrial data networking standards their evolution, associated hardware and software
2. Be able to analyse and select proper protocol for device level and control level integration
3. Be able to establish/design networking for process control applications and industrialautomation
4. Be able to apply gained knowledge on networking to compare and choose a specific protocol for the given architecture.
5. Be able to infer the requirements of an industry and provide a wired or wireless solution for installing Industrial data network

TEXT BOOKS:

1. Mackay, S., Wright,E., Reynders,D., and Park,J., “Practical Industrial Data Networks: Design, Installation and Troubleshooting”, Newnes Publication, Elsevier, 2004.
2. Buchanan,W., “Computer Busses: Design and Application”, CRC Press, 2000.

REFERENCES:

1. Bowden,R., “HART Application Guide”, HART Communication Foundation, 1999.
2. Bela G.Liptak, “Instrument Engineers’ Handbook, Volume 3 : Process Software and Digital Networks”, 4th Edition, CRC Press, 2011.
3. Berge,J., “Field Buses for Process Control: Engineering, Operation, and Maintenance”, ISA Press, 2004.
4. Lawrence (Larry) M. Thompson and Tim Shaw, “Industrial Data Communications”, 5th Edition, ISA Press, 2015.
5. NPTEL Lecture notes on, “Computer Networks” by Department of Electrical Engg., IIT Kharagpur.

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MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO071.1	3	3	2	2	2	-	-	1	1	1	1	3	1	-	2
CO071.2	3	3	3	3	2	1	-	1	1	2	1	3	1	-	2
CO071.3	3	3	2	2	3	1	-	1	1	2	1	3	1	-	3
CO071.4	3	3	3	3	3	1	-	1	1	2	1	3	1	-	2
CO071.5	3	3	3	3	3	1	-	1	1	2	1	3	1	-	2
CO071	3	3	2.6	2.6	2.6	1	-	1	1	1.8	1	3	1	-	2.2

GE7071 DISASTER MANAGEMENT LT P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO DISASTERS 9

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

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

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

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and

Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

1. Identify hazards, disaster preparedness, and disaster mitigation techniques.
2. Recognize the role of IT, remote sensing, GIS, and GPS in risk reduction
3. Recognize the various roles played by different stockholders during disasters as well as the disaster management acts and standards.
4. Analyse the DM study as a case study by evaluating the data search, analysis, and presentation.
5. Develop Technological Advancements in Disaster Risk Reduction: Benefits and Issues.

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

REFERENCES

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO071.1	2	-	-	-	-	3	-	2	3	3	3	3	3	-	-
CO071.2	1	-	-	-	-	2	-	2	3	3	3	3	2	-	-
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CO071.4	3	3	2	-	-	2	2	2	2	2	3	3	2	-	-
CO071.5	3	2	1	-	-	1	-	2	-	1	3	3	2	-	-
CO071	2	3	1.3	-	-	2.2	2	2.2	2.2	2	3	3	2.1	-	-

GE7074 HUMAN RIGHTS LT P C
3 0 0 3

OBJECTIVES

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

UNIT I **9**

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

UNIT II **9**

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

UNIT III **9**

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

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

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

TOTAL : 45 PERIODS

COURSE OUTCOMES

Attested

After completion the above subject, students will be able to understand

1. Engineering students will acquire the basic knowledge of human rights.
2. Will able to know the basics of UN Laws
3. Will able to know the declaration of human rights
4. Will able to know the human rights protection in India
5. Will able to know the evolution concept of human rights

REFERENCES:

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO074.1	**1**	1	1	1	1	1	**1**	**1**							1
CO074.2	**2**	1	1	1	1	1	**3**	**2**							1
CO074.3	**3**	1	1	1	1	1	**3**	**2**							1
CO074.4	**1**	1	1	1	1	1	**2**	**3**							1
CO074.5	**3**	1	1	1	1	1	**3**	**1**							1
CO074	**2**	1	1	1	1	1	**2.4**	**1.8**							1

GE 7351 **ENGINEERING ETHICS AND HUMAN VALUES** L T P C 3 0 0 3

(Common to all branches)

COURSE OBJECTIVES

1. To emphasise into awareness on Engineering Ethics and Human Values.
2. To understand social responsibility of an engineer.
3. To appreciate ethical dilemma while discharging duties in professional life.

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UNIT I HUMAN VALUES 3

Morals, Values and Ethics – Integrity – Work Ethic – Honesty – Courage –Empathy – SelfConfidence – Discrimination- Character.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' - variety of moral issued - 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 –Professional Ideals and Virtues - uses of ethical theories. Valuing Time – Co-operation – Commitment –

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics – Importance of Industrial Standards - a balanced outlook on law – anticorruption- occupational crime the challenger case study.

UNIT IV ENGINEER'S RIGHTS AND RESPONSIBILITIES ON SAFETY 12

Collegiality and loyalty – Respect for authority – Collective Bargaining – Confidentiality- Conflict of interest – Occupational Crime – Professional Rights – IPR- Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk - the Three Mile Island, Bhopal Gas plant and chernobyl as case studies.

UNIT V GLOBAL ISSUES 12

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-Sample code of conduct.

TOTAL : 45 PERIODS

COURSE OUTCOMES(C):

1. Students will have the ability to perform with professionalism, understand their rights, legal, ethical issues and their responsibilities as it pertains to engineering profession with engaging in life-long learning with knowledge of contemporary issues.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 2005.
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000 (Indian
3. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.

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REFERENCES

1. Charles D. Fleddermann, "Engineering Ethics", Pearson Education / Prentice Hall, New Jersey, 2004
2. Charles E Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Leatning, United States, 2000
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford Press , 2000
5. R.Subramanian , "Professional Ethics ",Oxford University Press ,Reprint ,2015.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO652.1	0.9				0.9					0.6		0.6	0.6	0.9	0.6
CO652.2	0.9									0.6		0.6	0.6	0.6	
CO652.3	0.9				0.9					0.6		0.6	0.6	0.6	
CO652.4	0.9				0.9					0.6		0.6	0.6	0.6	
CO652.5	0.9		0.6		0.9					0.6		0.6	0.6	0.6	
CO652	0.9		0.9		0.9					0.6		0.6	0.6	0.6	

GE7652 TOTAL QUALITY MANAGEMENT L T PC

3 0 0 3

AIM

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

COURSE OBJECTIVES

1. To understand the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
2. To understand the TQM Principles.
3. To learn and apply the various tools and techniques of TQM.
4. To understand and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM –-Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

Leadership--The Deming Philosophy, Quality council, Quality statements and Strategic planning-- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention – Employee involvement –

Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal--Continuous process improvement –Juran Trilogy, PDSA cycle, 5s and Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I 9

The seven traditional tools of quality – New management tools – Six-sigma Process Capability– Bench marking – Reasons to bench mark, Bench marking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Bench Marking – FMEA – Intent of FMEA, FMEA Documentation, Stages, Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II 9

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

UNIT V QUALITY MANAGEMENT SYSTEM 9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES(CO):

1. Importance of understanding the quality management and selecting suitable enterprise.
2. Demonstrate the manufacturing enterprise quality, importance in maintaining role and responsibility of managing the quality.
3. Ability to deployment various method in maintaining the quality of the product
4. Ability to gain the knowledge in improving the quality within the finance
5. To maintain the standard of product within the suitable and manage within the environmental condition

TEXT BOOK:

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

REFERENCES:

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third

Edition, 2003.

3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006 .
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases",Prentice Hall (India) Pvt. Ltd., 2006.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

PO,PSO/ CO	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO652.1	2	-	-	-	3	3	2	2	-	-	1	3	2	-	-
CO652.2	2	-	-	-	-	3	2	2	-	-	2	3	1	-	-
CO652.3	2	-	2	-	1	3	3	2	-	-	2	3	2	-	-
CO652.4	2	2	3	-	-	2	-	2	-	-	3	3	2	-	-
CO652.5	2	-	-	-	2	3	3	2	-	-	1	3	1	-	-
CO652	2	2	2.5	-	3	2.8	2	2	-	-	1.8	3	1.6	-	-

GE7072 FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT

L T P C
3 0 0 3

COURSE OBJECTIVES:

1. To understand the global trends and development methodologies of various types of products and services
2. To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
3. To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification
4. To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
5. To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I FUNDAMENTALS OF PRODUCT DEVELOPMENT 9

Global Trends Analysis and Product decision - Social Trends - Technical Trends- Economical Trends - Environmental Trends - Political/Policy Trends **- Introduction to Product Development Methodologies and Management -** Overview of Products and Services - Types of Product Development - Overview of Product Development methodologies **-** Product Life Cycle – Product Development Planning and Management.

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability

Matrix and Analysis - Requirement Management - **System Design & Modeling -** Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING **9**

Conceptualization - Industrial Design and User Interface Design - Introduction to Concept generation Techniques – **Challenges in Integration of Engineering Disciplines** - Concept Screening & Evaluation - **Detailed Design -** Component Design and Verification – **Mechanical, Electronics and Software Subsystems** - High Level Design/Low Level Design of S/W Program - Types of Prototypes, S/W Testing- Hardware Schematic, Component design, Layout and Hardware Testing – **Prototyping -** Introduction to Rapid Prototyping and Rapid Manufacturing - **System Integration, Testing, Certification and Documentation**

UNIT IV SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT **9**

Introduction to Product verification processes and stages - Introduction to Product Validation processes and stages - Product Testing Standards and Certification - Product Documentation - **Sustenance** -Maintenance and Repair – Enhancements - **Product EoL -** Obsolescence Management – Configuration Management - EoL Disposal

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY **9**

The Industry - Engineering Services Industry - Product Development in Industry versus Academia –**The IPD Essentials -** Introduction to Vertical Specific Product Development processes -Manufacturing/Purchase and Assembly of Systems - Integration of Mechanical, Embedded and Software Systems – Product Development Trade-offs - Intellectual Property Rights and Confidentiality – Security and Configuration Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Define, formulate and analyze a problem
2. Solve specific problems independently or as part of a team
3. Gain knowledge of the Innovation & Product Development process in the Business Context
4. Work independently as well as in teams
5. Manage a project from start to finish

TEXTBOOKS:

1. Book specially prepared by NASSCOM as per the MoU.
2. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
3. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh

Edition, 2005.

REFERENCES:

1. Hiriyappa B, “Corporate Strategy – Managing the Business”, Author House, 2013.
2. Peter F Drucker, “People and Performance”, Butterworth – Heinemann [Elsevier], Oxford, 2004.
3. Vinod Kumar Garg and Venkita Krishnan N K, “Enterprise Resource Planning – Concepts”, Second Edition, Prentice Hall, 2003.
4. Mark S Sanders and Ernest J McCormick, "Human Factors in Engineering and Design", McGraw Hill Education, Seventh Edition, 2013.

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CO072.4	-	-	1	1	-	-	-	-	-	-	1	3	-	-	-
CO072.5	-	--	-		-	2	-	-	-	-	1	2	-	-	-
CO072	2	2	2.6	2.6	1	1.3	1	1	1	1	1	2	-	-	-

Attested