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 endeavor is 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 Control Engineering.
- Enhance the core competency of the students to cater to the needs of the industries and research 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 educational programs.
- Carry out interdisciplinary research and consultancy in the cutting-edge technology.

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

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: Start their own company or nurture innovative ideas and creativity in their work place.
PEO4: Uphold the highest integrity and social responsibility in all their endeavors.
PEO5: Exhibit leadership and inter-personal skills.

PROGRAMME OUTCOMES (POs):

Engineering Graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of their formation to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
PEO 1	3	3	3	3	3	2	2	2	3	3	3	3	3	3	3
PEO 2	2	2	2	2	2							3	2	2	2
PEO 3	2	2	2	2											
PEO 4						2	2	3	3						
PEO 5								2	3	3	3				

Mapping of Course Outcome and Programme Outcome

	Course Name	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12	PSO1	PSO2	PSO3
SEM I	**THEORY**															
	Technical English						3	3	3	3	3		3			
	Engineering Mathematics I	3	3	3	2	2							2			
	Engineering Physics	3	3	3	2	2										
	Engineering Chemistry	3	3	3	2	2										
	Engineering Graphics	3	3	3	3	3	3			1		2	3			
	PRACTICALS															
	Basic Sciences Laboratory	3	3	3	3	3										
	Workshop Practices Laboratory	3	3	3	3	3				2		1				
	THEORY															
	Engineering Mathematics II	3	3	3	3	3				1			3			
	Physics for Electronic Sciences	3	3	3	3	3				1		1				
	Engineering Mechanics	3	3	3	3	3				1		1				

SEM II	Problem Solving and Python Programming	3	3	3	3	3						3	3			
	Electronics for Analog Signal Processing- I	3	2.1	2.3	1.7	2.7	1		1	1	2		2		2	
	PRACTICALS															
	Problem Solving and Python Programming Laboratory	3	3	3	3	3						3	3			
	Analog Signal Processing Laboratory	2.9	2.4	2.4	1.6	2.3	1		1.5	1.7	2.3		2.3		2	
SEM III	**THEORY**															
	Thermodynamics and Fluid Mechanics	2.2	3	3			3		1		1		2	3		
	Analysis of Electric Circuits	2.8	2.3	2.5	1.6	2.16	1					1	2.16	1	1.8	
	Electrical Machines	3	2.5	1	1		3	3	1	3	1		2.5	2		
	Signals and Systems	2.5	2.5	2	1.7	2	1.5	1					1.5	3	3	1
	PRACTICALS															

	Circuit Simulation Laboratory	3	3	3	2.6	3			1	2	1		2		3	
	Electrical Machines Laboratory	3	2	3	1.6	2.17			1	1.3	1	3	2	2		
SEM IV	**THEORY**															
	Environmental Sciences	2					3	3	2		1	1	2	2		
	Electronics for Analog Signal Processing- II	3	2.1	2.1	1.8	2.5	1		1	1	2		2.3		2	
	Digital System Design	3	3	2.75	2.75	2.75	1	1	2	2	2	3	3		2	
	Instrument Transducers	3	2.8	2.8	2.75	2.25	1.5	1	1		1		1	3	3	
	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															
	Sensors and Signal Conditioning Circuits Laboratory	2.7	2.6	2.3	2.7	2.2			2	3	2		1	1.1	2	3

SEM V	**THEORY**															
	Project Management and Finance	3	2.7	1.75			1.8	2	2	2.7	1.8	2.8	2.8	2.1		
	Discrete Time Signal Processing	2.7	2.5	2	2.7	2	1.5	2					1.7	2.3	3	
	Industrial Instrumentation - I	3	1.8	1.8	1.5	1.9	1.6	1.2	1.2	1	1	1.2	1.2	3		
	Control System Analysis and Design	3	2.3	2.5	2.5	2.3			1		1			2	3	3
	PRACTICALS															
	Embedded System Design Laboratory	3	3	3	2.85	3	3	1	1	3	2	1	3	1.6	2	
	Control and Instrumentation Laboratory	3	3	3		3			1	3	1.25		2	3	2	
SEM VI	**THEORY**															
	Power Electronics, Drives and Control	1.6	1.8	2.2	1.2	2.2						1	1.8		1	1.5
	Industrial Instrumentation - II	2.1	1.9	2	2.1		1	1.7	1.7				1	2.9		
	Process Control	3	2.5	3	3	2.4			1		1				3	2

	PRACTICALS															
	Process Control and Instrumentation Laboratory	2.8	2.4	2.4	3	2.4	1.8	1.8	2.9	2.8	3	2.2	2.7	2	2	
	Industrial Automation Systems Laboratory	3	2.8	2.8	2.8	2.8	1.7	1.4	2.4	2.7	2.6	2.7	2.3	2	2	3
SEM VII	**THEORY**															
	Industrial Data Communication	3	3	2.6	2.6	2.6	1		2	1	1.8	1	3	1		2
	Introduction to Process Data Analytics	3	3	2	2	3			1		1		3	3	1.3	1.3
	Introduction to Industrial Processes, Measurement and Control	3	3	1.5	3	2.5	2	2	1		1.16	1.5	1	3	3	2.3
	PRACTICALS															
	Instrumentation System Design Laboratory	3	3	3	2	2.4	1	1.8	3	1.6	1.6		1	2	2	
	Summer Internship / Summer Project (Minimum 4 Weeks)	2.5	2.5	2	2	1	2	1.5	3	1.5	3	3	2	3	3	3
	Project I	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
SEM VIII	**PRACTICALS**															
	Project II	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

ELECTIVES	**THEORY**															
	Analytical Instrumentation	2	1.8	1.2	1.2	2.6	1.6	1	1	1	1	1	1	1	1	1
	Biomedical Instrumentation	2.8	2.5	3	3	2.5	2		2	2.3	1		2	3	2	
	Fiber optics and laser Instrumentation	3	3	3		2.25	3			1.7		1	2.7	2		
	Safety Instrumented System	2	3	2.75	2.67	2	3	2	1	1	2.67	1	1	2.57	2.57	2
	Instrumentation Standards	2	3	3	3	3	2.5	2..5	1	2	2			2	2	3
	Fundamentals of Nano science and MEMS	3	2.5	3		3		3	1	3	1		3	3	2	
	Modern Control Theory	3	3	2	2	2			1		1				3	
	Advanced topics in PID control	3	3	3	3	3			1		3				3	
	Model predictive control	3	3	2	3	3			1		3				3	
	Fault detection and diagnosis	3	2	3	2				1		3				3	
	Cyber Security for Industrial Automation	3	3	3	3	3			1		1		3			3
	Cyber Physical Systems	3	3	2.7	3	3			1		1				3	
	Control Valves	3	3	3	3	3			1		1		3		3	
	Machine Learning	2.8	3	2.7	2	2.3	2		1.3		1	2	3		3	
	Microcontroller Based System design	3	3	3	2.75	3			1		1		3		3	

	Introduction to Image and Video Processing	3		2.5	2	3			1		1		3		3	
	Principles of Communication Engineering	3			2	3			1		1				3	
	Industrial Internet of Things	3	2.5	2.3	2.3	2.6	1.7	1.7	1	1	2	1	2	1.2	2.6	2.4
	Digital VLSI	2	2	2	2	1	1.5					1	2		3	
	Metrology and Measurements	2.3	2.3	2.5	2.4	2.5	3	2.5	2	2	2	4	1	3	2.8	2.4
	Aircraft Systems Engineering	2	1	1			2	2	2	2	2	2	2	2		
	Avionics systems	2	1	1	1			2					2			
	Robotic Technology	1						2					2			2
	Database Management Systems	2	1	1	1	1	2	2	1	1	1	1	2	1		
	Computer Networks	3	3	2.6	2.6	2.6	1		2	1	1.8	1	3	1		2
	Computer Architecture	2	1	1	1							1	2	1		
	Programming and Data Structures	2	1	1	1		2			1			2	1		

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING
CURRICULA AND SYLLABI FOR I TO VIII SEMESTERS
(Applicable to Students admitted from the Academic Year 2020-2021 onwards)

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HS5151	Technical English	HSMC	4	0	0	4	4
2.	MA5158	Engineering Mathematics I	BSC	3	1	0	4	4
3.	PH5151	Engineering Physics	BSC	3	0	0	3	3
4.	CY5151	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE5151	Engineering Graphics	ESC	1	0	4	5	3
PRACTICALS								
6.	BS5161	Basic Sciences Laboratory	BSC	0	0	4	4	2
7.	GE5162	Workshop Practices Laboratory	ESC	0	0	4	4	2
			TOTAL	**14**	**1**	**12**	**27**	**21**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5252	Engineering Mathematics II	BSC	3	1	0	4	4
2.	PH5252	Physics for Electronic Sciences	BSC	3	0	0	3	3
3.	GE5152	Engineering Mechanics	ESC	3	1	0	4	4
4.	GE5153	Problem Solving and Python Programming	ESC	3	0	0	3	3
5.	EI5201	Electronics for Analog Signal Processing- I	ESC	3	0	0	3	3
PRACTICALS								
6.	GE5161	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
7.	EI5211	Analog Signal Processing Laboratory	ESC	0	0	4	4	2
			TOTAL	**15**	**2**	**8**	**25**	**21**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Elective - Humanities I	HSMC	3	0	0	3	3
2.	MA5356	Linear Algebra and Numerical Methods	BSC	3	1	0	4	4
3.	PR5301	Thermodynamics and Fluid Mechanics	ESC	3	0	0	3	3
4.	EI5301	Analysis of Electric Circuits	PCC	3	0	0	3	3
5.	EI5302	Electrical Machines	PCC	3	0	0	3	3
6.	EI5303	Signals and Systems	PCC	3	0	0	3	3
PRACTICALS								
7.	EI5311	Circuit Simulation Laboratory	PCC	0	0	4	4	2
8.	EI5312	Electrical Machines Laboratory	PCC	0	0	4	4	2
TOTAL				**1 8**	**1**	**8**	**27**	**23**

SEMESTER IV

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Elective - Humanities II	HSMC	3	0	0	3	3
2.	GE5251	Environmental Sciences	BSC	3	0	0	3	3
3.		Audit Course - I*	AC	3	0	0	3	0
4.	EI5401	Electronics for Analog Signal Processing- II	PCC	3	0	0	3	3
5.	EI5402	Digital System Design	PCC	3	0	2	5	4
6.	EI5403	Instrument Transducers	PCC	3	0	0	3	3
7.	EI5404	Electrical and Electronic Measurements	PCC	3	0	0	3	3
PRACTICALS								
8.	EI5411	Sensors and Signal Conditioning Circuits Laboratory	PCC	0	0	4	4	2
TOTAL				**21**	**0**	**6**	**27**	**21**

***Audit Course is optional**

SEMESTER V

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	HM5501	Project Management and Finance	HSMC	3	0	0	3	3
2.		Audit Course – II*	AC	3	0	0	3	0
3.	EI5501	Discrete Time Signal Processing	PCC	3	0	0	3	3
4.	EI5502	Industrial Instrumentation -I	PCC	3	0	0	3	3
5.	EI5503	Control System Analysis and Design	PCC	3	0	0	3	3
6.		Professional Elective - I	PEC	3	0	0	3	3
PRACTICALS								
7.	EI5511	Embedded System Design Laboratory	PCC	0	0	6	6	3
8.	EI5512	Control and Instrumentation Laboratory	PCC	0	0	4	4	2
			TOTAL	**18**	**0**	**10**	**28**	**20**

***Audit Course is optional**

SEMESTER VI

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EI5601	Power Electronics, Drives and Control	PCC	3	0	0	3	3
2.	EI5602	Industrial Instrumentation-II	PCC	3	0	0	3	3
3.	EI5603	Process Control	PCC	3	0	0	3	3
4.		Professional Elective - II	PEC	3	0	0	3	3
5.		Professional Elective - III	PEC	3	0	0	3	3
6.		Professional Elective - IV	PEC	3	0	0	3	3
7.		Open Elective - I	OEC	3	0	0	3	3
PRACTICALS								
7.	EI5611	Process Control and Instrumentation Laboratory	PCC	0	0	4	4	2
8.	EI5612	Industrial Automation Systems Laboratory	PCC	0	0	6	6	3
			TOTAL	**18**	**0**	**10**	**28**	**26**

SEMESTER VII

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	EI5701	Industrial Data Communication	PCC	3	0	0	3	3
2.	EI5702	Introduction to Process Data Analytics	PCC	3	0	0	3	3
3.	EI5703	Introduction to Industrial Processes, Measurement and Control	PCC	3	0	0	3	3
4.		Professional Elective - V	PEC	3	0	0	3	3
5.		Professional Elective - VI	PEC	3	0	0	3	3
6.		Professional Elective - VII	PEC	3	0	0	3	3
7.		Open Elective - II	OEC	3	0	0	3	3
PRACTICALS								
7.	EI5711	Instrumentation System Design Laboratory	PCC	0	0	4	4	2
8.	EI5712	Summer Internship Summer Project (Minimum 4 Weeks)	EEC	0	0	0	0	2
9.	EI5713	Project I	EEC	0	0	6	6	3
			TOTAL	**18**	**0**	**10**	**28**	**28**

SEMESTER VIII

S. NO.	COURSE CODE	COURSETITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
3.	EI5811	Project II	EEC	0	0	16	16	8
			TOTAL	**6**	**0**	**16**	**22**	**14**

TOTAL CREDITS:168

HUMANITIES AND SOCIAL SCIENCE INCLUDED MANAGEMENT COURSES (HSMC)

S.NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Period		
1.	HS5151	Technical English I	4	0	0	4	I
2.	HM5501	Project Management and Finance	3	0	0	3	V
TOTAL						7	

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5171	Language and Communication	3	0	0	3
2.	HU5172	Values and Ethics	3	0	0	3
3.	HU5173	Human Relations at Work	3	0	0	3
4.	HU5174	Psychological Process	3	0	0	3
5.	HU5175	Education, Technology and Society	3	0	0	3
6.	HU5176	Philosophy	3	0	0	3
7.	HU5177	Applications of Psychology in Everyday Life	3	0	0	3

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	HU5271	Gender Culture and Development	3	0	0	3
2.	HU5272	Ethics and Holistic Life	3	0	0	3
3.	HU5273	Law and Engineering	3	0	0	3
4.	HU5274	Film Appreciation	3	0	0	3
5.	HU5275	Fundamentals of Language and Linguistics	3	0	0	3
6.	HU5276	Understanding Society and Culture through Literature	3	0	0	3

BASIC SCIENCE COURSE (BSC)

S.NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	Semester
			Lecture	Tutorial	Period		
1.	MA5158	Engineering Mathematics I	3	1	0	4	I
2.	PH5151	Engineering Physics	3	0	0	3	I
3.	CY5151	Engineering Chemistry	3	0	0	3	I
4.	BS5161	Basic Sciences Laboratory	0	0	4	2	I
5.	MA5252	Engineering Mathematics II	3	1	0	4	II
6.	PH5252	Physics for Electronic Sciences	3	0	0	3	II
7.	MA5356	Linear Algebra and Numerical Methods	3	1	0	4	III
8.	GE5251	Environmental Sciences	3	0	0	3	IV
TOTAL						**26**	

ENGINEERING SCIENCE COURSE (ESC)

S.NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	Semester
			Lecture	Tutorial	Period		
1.	GE5151	Engineering Graphics	1	0	4	3	I
2.	GE5162	Workshop Practices Laboratory	0	0	4	2	I
3.	GE5152	Engineering Mechanics	3	1	0	4	II
4.	GE5153	Problem Solving and Python Programming	3	0	0	3	II
5.	EI5201	Electronics for Analog Signal Processing- I	3	0	0	3	II
6.	GE5161	Problem Solving and Python Programming Laboratory	0	0	4	2	II
7.	EI5211	Analog Signal Processing Laboratory	0	0	4	2	II
8.	PR5301	Thermodynamics and Fluid Mechanics	3	0	0	3	III
TOTAL						**22**	

PROFESSIONAL CORE COURSES (PCC)

S.NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	Semester
			Lecture	Tutorial	Period		
1.	EI5301	Analysis of Electric Circuits	3	0	0	3	III

2.	EI5302	Electrical Machines	3	0	0	3	III
3.	EI5303	Signals and Systems	3	0	0	3	III
4.	EI5311	Circuit Simulation Laboratory	0	0	4	2	III
5.	EI5312	Electrical Machines Laboratory	0	0	4	2	III
6.	EI5401	Electronics for Analog Signal Processing - II	3	0	0	3	IV
7.	EI5402	Digital System Design	3	0	2	4	IV
8.	EI5403	Instrument Transducers	3	0	0	3	IV
9.	EI5404	Electrical and Electronic Measurements	3	0	0	3	IV
10.	EI5411	Sensors and Signal Conditioning Circuits Laboratory	0	0	4	2	IV
11.	EI5501	Discrete Time Signal Processing	3	0	0	3	V
12.	EI5502	Industrial Instrumentation - I	3	0	0	3	V
13.	EI5503	Control System Analysis and Design	3	0	0	3	V
14.	EI5511	Embedded System Design Laboratory	0	0	6	3	V
15.	EI5512	Control and Instrumentation Laboratory	0	0	4	2	V
16.	EI5601	Power Electronics Drives and Control	3	0	0	3	VI
17.	EI5602	Industrial Instrumentation - II	3	0	0	3	VI
18.	EI5603	Process Control	3	0	0	3	VI
19.	EI5611	Process Control and Instrumentation Laboratory	0	0	4	2	VI
20.	EI5612	Industrial Automation Systems Laboratory	0	0	6	3	VI
21.	EI5701	Industrial Data Communication	3	0	0	3	VII
22.	EI5702	Introduction to Process Data Analytics	3	0	0	3	VII
23.	EI5703	Introduction to Industrial Processes, Measurement and Control	3	0	0	3	VII
24.	EI5711	Instrumentation System Design Laboratory	0	0	4	2	VII
TOTAL						**67**	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	Semester
			Lecture	Tutorial	Period		
1.	EI5712	Summer Internship / Summer Project (Minimum 4 Weeks)	0	0	0	2	VII
2.	EI5713	Project I	0	0	6	3	VII
3.	EI5811	Project II	0	0	16	8	VIII
					TOTAL	13	

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

Sl. No	Course Code	Course Title	Periods per week			Credits
			Lecture	Tutorial	Practical	
1.	AD5091	Constitution of India	3	0	0	0
2.	AD5092	Value Education	3	0	0	0
3.	AD5093	Pedagogy Studies	3	0	0	0
4.	AD5094	Stress Management by Yoga	3	0	0	0
5.	AD5095	Personality Development Through Life Enlightenment Skills	3	0	0	0
6.	AD5096	Unnat Bharat Abhiyan	3	0	0	0
7.	AD5097	Essence of Indian Knowledge Tradition	3	0	0	0
8.	AD5098	Sanga Tamil Literature Appreciation	3	0	0	0

PROFESSIONAL ELECTIVES (PE)

S.NO.	COURSE CODE	COURSETITLE	CATAGORY	L	T	P	CONTACT PERIODS	CREDITS
1.	EI5001	Analytical Instrumentation	PE	3	0	0	3	3
2.	EI5002	Biomedical Instrumentation	PE	3	0	0	3	3
3.	EI5003	Fiber optics and Laser Instrumentation	PE	3	0	0	3	3
4.	EI5004	Safety Instrumented System	PE	3	0	0	3	3

5.	EI5005	Instrumentation Standards	PE	3	0	0	3	3
6.	EI5006	Fundamentals of NanoScience and MEMS	PE	3	0	0	3	3
7.	EI5007	Modern Control Theory	PE	3	0	0	3	3
8.	EI5008	Advanced Topics in PIDControl	PE	3	0	0	3	3
9.	EI5009	Model Predictive Control	PE	3	0	0	3	3
10.	EI5010	Fault Detection and Diagnosis	PE	3	0	0	3	3
11.	EI5011	Cyber Security for Industrial Automation	PE	3	0	0	3	3
12.	EI5012	Cyber Physical Systems	PE	3	0	0	3	3
13.	EI5013	Control Valves	PE	3	0	0	3	3
14.	EI5014	Machine Learning	PE	3	0	0	3	3
15.	EI5015	Microcontroller BasedSystem Design	PE	3	0	0	3	3
16.	EI5016	Introduction to Image and Video Processing	PE	3	0	0	3	3
17.	EI5017	Principles of Communication Engineering	PE	3	0	0	3	3
18.	EI5018	Industrial Internet of Things	PE	3	0	0	3	3
19.	EC5651	Digital VLSI	PE	3	0	0	3	3
20.	EC5075	Mixed Signal IC Design	PE	3	0	0	3	3
21.	EC5073	Electromagnetic Interference and Compatibility	PE	3	0	0	3	3
22.	ME5552	Metrology and Measurements	PE	3	0	0	3	3
23.	AU5551	Automotive Electrical and Electronics Systems	PE	3	0	0	3	3
24.	AU5072	Vehicle Control Systems	PE	3	0	0	3	3
25.	AU5651	Electric and Hybrid Vehicles	PE	3	0	0	3	3
26.	AU5071	Automotive Instrumentation and Testing	PE	3	0	0	3	3
27.	AE5071	Aircraft Systems Engineering	PE	3	0	0	3	3

28.	AE5072	Avionics Systems	PE	3	0	0	3	3
29.	PR5073	Robotic Technology	PE	3	0	0	3	3
30.	IT5351	Database Management Systems	PE	3	0	0	3	3
31.	IT5551	Computer Networks	PE	3	0	0	3	3
32.	IT5451	Computer Architecture	PE	3	0	0	3	3
33.	IT5352	Programming and Data Structures	PE	3	0	0	3	3

Summary

Sl. No	Subject Area	Credits per Semester								Credits Total
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	4		3	3	3				13
2	BSC	12	7	4	3					26
3	ESC	5	14	3						22
4	PCC			13	15	14	14	11		67
5	PEC					3	6	6	6	21
6	OEC						3	3		6
7	EEC							5	8	13
8	Non-Credit /(Audit Course)				0	0				0
									TOTAL	**168**

HS5151	TECHNICAL ENGLISH	L	T	P	C
		4	0	0	4

OBJECTIVES:

The first semester English course entitled 'Technical English' aims to,

- Familiarize first year students of engineering and technology with the fundamental aspects of technical English.
- Develop all the four language skills by giving sufficient practice in the use of the skills in real life contexts.
- Enhance the linguistic and communicative competence of first year engineering and technology students.

UNIT I INTRODUCING ONESELF **12**

Listening: Listening and filling a form, listening to speeches by specialists from various branches of engineering and completing activities such as answering questions, identifying the main ideas of the listening text, style of the speaker (tone and tenor) – **Speaking**: Introducing oneself –introducing friend/ family - **Reading:** Descriptive passages (from newspapers / magazines)- **Writing**: Writing a paragraph (native place, school life)- **Grammar:** Simple present, present continuous – **Vocabulary Development**: One word substitution

UNIT II DIALOGUE WRITING **12**

Listening: Listening to conversations (asking for and giving directions) –**Speaking:** making conversation using (asking for directions, making an enquiry), Role plays-dialogues- **Reading:** Reading a print interview and answering comprehension questions-**Writing**: Writing a checklist, Dialogue writing- **Grammar**: Simple past – question formation (Wh- questions, Yes or No questions, Tag questions)- **Vocabulary Development**: Stress shift, lexical items related to the theme of the given unit.

UNIT III FORMAL LETTER WRITING **12**

Listening: Listening to speeches by famous people and identifying the central message of the speech – answering multiple-choice questions)-**Speaking:** Giving short talks on a given topic- **Reading:** Reading motivational essays on famous engineers and technologists (answering open-ended and closed questions) **Writing:** Writing formal letters/ emails (Complaint letters)-**Grammar**: Future Tense forms of verbs, subject and verb agreement-**Vocabulary Development**: Collocations – Fixed expressions

UNIT IV WRITING COMPLAINT LETTERS **12**

Listening: Listening to short talks (5 minutes duration and fill a table, gap-filling exercise) note taking/note making- **Speaking:** Small group discussion, giving recommendations-**Reading:** Reading problem – solution articles/essays drawn from various sources- **Writing:** Making recommendations – Writing a letter/ sending an email to the Editor- note making- **Grammar:** Modals – Phrasal verbs – cause and effect sentences- **Vocabulary Development**: Connectives, use of cohesive devices in writing, technical vocabulary.

UNIT V WRITING DEFINITIONS AND PRODUCT DESCRIPTION **12**

Listening: Listening to a product description (labeling and gap filling) exercises- **Speaking:** Describing a product and comparing and contrasting it with other products- **Reading**: Reading graphical material for comparison (advertisements)-**Writing:** Writing Definitions (short and

long) – compare and contrast paragraphs- **Grammar:** Adjectives – Degrees of comparison compound nouns- **Vocabulary Development**: Use of discourse markers – suffixes (adjectival endings).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Exposure to basic aspects of technical English.
CO2: The confidence to communicate effectively I various academic situations.
CO3: Learnt the use of basic features of Technical English.
CO4: Small group discussions and note making
CO5: Listening to a product description, reading and writing

Textbook:

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

Assessment Pattern

- Assessments will assess all the four skills through both pen and paper and computer- b a s e d tests.
- Assessments can be pen and paper based, quizzes.

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	PSO 1	PSO 2	PSO 3
CO101.1						3	3	3	3	3		3			
CO101.2						3	3	3	3	3		3			
CO101.3						3	3	3	3	3		3			
CO101.4						3	3	3	3	3		3			
CO101.5						3	3	3	3	3		3			
CO101						3	3	3	3	3		3			

MA5158	ENGINEERING MATHEMATI CS – I	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT I MATRICES **12**

Eigen values 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 DIFFERENTIAL CALCULUS **12**

Limit of function – One sided limit – Limit Laws – Continuity – left and right continuity – types of discontinuities – Intermediate Value Theorem – Derivatives of a function Differentiation rules – Chain rule – Implicit differentiation – logarithmic differentiation – Maxima and minima – Mean value theorem – (Optional: Polar coordinate system – Differentiation in polar coordinates).

UNIT III 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 IV INTEGRAL CALCULUS **12**

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

UNIT V MULTIPLE INTEGRALS **12**

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After completion the above subject, students will be able to understand
CO1: Use the matrix algebra methods for solving practical problems.
CO2: Apply differential calculus tools in solving various application problems.
CO3: Able to use differential calculus ideas on several variable functions.
CO4: Apply different methods of integration in solving practical problems.
CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXTBOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.
2. James Stewart, "Calculus with Early Transcendental Functions", Cengage Learning, 6th Edition, New Delhi, 2013.
3. Joel Hass, Christopher Heil and Maurice D.Weir, "Thomas' Calculus", Pearson, 14th Edition, New Delhi, 2018.
4. Narayanan S. and Manicavachagom Pillai T. K., "Calculus" Volume I and II,S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education2nd Edition, 5th Reprint, Delhi, 2009.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5thEdition, New Delhi, 2017.
5. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th

Edition, New Delhi, 2012.

6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 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	PSO 1	PSO 2	PSO 3
CO102.1	3	3	3	2	2							2			
CO102.2	3	3	3	2	2							2			
CO102.3	3	3	3	2	2							2			
CO102.4	3	3	3	2	2							2			
CO102.5	3	3	3	2	2							2			
CO102	3	3	3	2	2							2			

PH5151	ENGINEERING PHYSICS (Common to all branches of B.E / B.Tech programmes)	L	T	P	C
		3	0	0	3

OBJECTIVE

- To make the students in understanding the importance of mechanics.
- To equip the students on the knowledge of electromagnetic waves.
- To introduce the basics of oscillations, optics and lasers.
- To enable the students in understanding the importance of quantum physics.
- To elucidate the application of quantum mechanics towards the formation of energy bands in crystalline materials.

UNIT I MECHANICS **9**

Moment of inertia (M.I) - Radius of gyration - Theorems of M .I - M.I of circular disc, solid cylinder , hollow cylinder , solid sphere and hollow sphere K.E of a rotating body – M.I of a diatomic molecule – Rotational energy state of a rigid diatomic molecule --- centre of mass – conservation of linear momentum – Relation between Torque and angular momentum Torsional pendulum.

UNIT II ELECTROMAGNETIC WAVES **9**

Gauss's law – Faraday's law - Ampere's law - The Maxwell's equations wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS **9**

Simple harmonic motion - resonance - waves on a string - standing waves - traveling waves Energy transfer of a wave - sound waves - Doppler effect - reflection and refraction of light waves total internal reflection - interference - interferometers - air wedge experiment. Theory of laser characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion Nd-YAG laser, CO_2 laser, semiconductor laser applications.

UNIT IV BASIC QUANTUM MECHANICS **9**

Photons and light waves - Electrons and matter waves The Schrodinger equation (Time dependent

and time independent forms) - meaning of wave function - Normalization - Particle in a infinite potential well Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS 9

The harmonic oscillator - Barrier penetration and quantum tunneling - Tunneling microscope Resonant diode - Finite potential wells - particle in a three-dimensional box Bloch's Theorem for particles in a periodic potential, Kronig -Penney model and origin of energy bands.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understanding the importance of mechanics.
CO2: Express the knowledge of electromagnetic waves.
CO3: Know the basics of oscillations, optics and lasers.
CO4: Understanding the importance of quantum physics.
CO5: Apply quantum mechanical principles towards the formation of energy bands in crystalline materials.

TEXT BOOKS

1. D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education, 2017.
2. D.Halliday, R.Resnick and J.Walker. Principles of Physics. John Wiley & Sons, 2015.
3. N.Garcia, A.Damask and S.Schwarz. Physics for Computer Science Students. Springer- Verlag, 2012.

REFERENCES

1. R.Wolfson. Essential University Physics. Volume 1 & 2 Pearson, 2016.
2. D.J.Griffiths. Introduction to Electrodynamics. Pearson Education, 2015
3. K.Thyagarajan and A.Ghatak. Lasers: Fundamentals and Applications. Springer, 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	PSO 1	PSO 2	PSO 3
CO103.1	3	3	3	2	2										
CO103.2	3	3	3	2	2										
CO103.3	3	3	3	2	2										
CO103.4	3	3	3	2	2										
CO103.5	3	3	3	2	2										
CO103	3	3	3	2	2										

CY5151	ENGINEERING CHEMISTRY (COMMON TO ALL BRANCHES)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of polymers, their properties and some of the important applications.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To facilitate the understanding of the laws of photochemistry, photo processes and instrumentation & applications of spectroscopic techniques.

- To familiarize the operating principles and applications of energy conversion, its processes and storage devices.
- To inculcate sound understanding of water quality parameters and water treatment techniques.

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 poly dispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Structure, Properties and uses of: PE, PVC, PC, PTFE, PP, Nylon 6, Nylon 66, Bakelite, Epoxy; Conducting polymers – polyaniline and polypyrrole.

UNIT II NANOCHEMISTRY **9**

Basics-distinction between molecules, nanomaterials and bulk materials; size-dependent properties. Types –nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Characterization - Scanning Electron Microscope and Transmission Electron Microscope Principle and instrumentation (block diagram). Properties (optical, electrical, mechanical and magnetic) and Applications of nanomaterials medicine, agriculture, electronics and catalysis.

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY **9**

Photochemistry: Laws of photochemistry Grotthuss -Draper law, Stark-Einstein law and Lambert- Beer Law (derivation and problems). Photo physical processes – Jablonski diagram. Chemiluminescence, photo-sensitization and photo-quenching – mechanism and examples. Spectroscopy: Electromagnetic spectrum - absorption of radiation electronic, vibrational and rotational transitions. Width and intensities of spectral lines. Atomic absorption spectroscopy, UV-Vis and IR spectroscopy- principles, instrumentation (Block diagram) and applications.

UNIT IV ENERGY CONVERSIONS AND STORAGE **9**

Nuclear fission - controlled nuclear fission - nuclear fusion differences between nuclear fission and fusion - nuclear chain reactions - nuclear energy-light water nuclear power plant – fast breeder reactor. Solar energy conversion - solar cells. Wind energy. Batteries types of batteries – Primary battery (dry cell), secondary battery (lead acid, nickel-cadmium and lithium-ion-battery). Fuel cells – H_2-O_2 and microbial fuel cell. Explosives – classification, examples: TNT, RDX, Dynamite; Rocket fuels and propellants – definition and uses.

UNIT V WATER TECHNOLOGY **9**

Water – sources and impurities – water quality parameters: colour, odour, pH, hardness, alkalinity, TDS, COD and BOD. Boiler feed water – requirement – troubles (scale & sludge, caustic embrittlement, boiler corrosion and priming & foaming. Internal conditioning – phosphate, calgon and carbonate treatment. External conditioning zeolite (permutit) and ion exchange demineralization.

Municipal water treatment process – primary (screening, sedimentation and coagulation), secondary (activated sludge process and trickling filter process) and tertiary (ozonolysis, UV treatment, chlorination, reverse osmosis).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: To recognize and apply basic knowledge on different types of polymeric materials, their general preparation methods and applications to futuristic material fabrication needs.

CO2: To identify and apply basic concepts of nano science and nanotechnology in designing the synthesis of nano materials for engineering and technology applications.

CO3: To identify and apply suitable spectroscopic technique for material analysis and studydifferent forms of photochemical reactions.
CO4: To recognize different forms of energy resources and apply them for suitable applications in energy sectors.
CO5:To demonstrate the knowledge of water and their quality in using at different industries.

TEXT BOOKS:

1. Jain P. C. & Monica Jain., "Engineering Chemistry", 16th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2015.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2012.
3. S.S.Dara, "A text book of Engineering Chemistry", Chand Publications, 2014.

REFERENCE BOOKS:

1. Schdeva M V, "Basics of Nano Chemistry", Anmol Publications Pvt Ltd
2. B.Sivasankar, "Instrumental Methods of Analysis", Oxford University Press. 2012.
3. Friedrich Emich, "Engineering Chemistry", Scientific International Ltd.
4. V RGowariker, N V Viswanathan and Jayadev Sreedhar, "Polymer Science" New AGE International Publishers, 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	PSO 1	PSO 2	PSO 3
CO104.1	3	3	3	2	2										
CO104.2	3	3	3	2	2										
CO104.3	3	3	3	2	2										
CO104.4	3	3	3	2	2										
CO104.5	3	3	3	2	2										
CO104	3	3	3	2	2										

GE5151	ENGINEERING GRAPHICS	L	T	P	C
		1	0	4	3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:

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

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)
Importance of graphics in engineering applications – Use of drafting instruments – BIS conventionsand 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 different methods – 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 15

Orthographic projection- principles-Principle 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 15

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 15

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 12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions 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)

Introduction to drafting packages and demonstration of their use

TOTAL (L: 15 + P: 60) =75 PERIODS

COURSE OUTCOMES:

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

CO1: Draw free hand sketching of basic geometrical shapes and multiple views of objects.
CO2: Draw orthographic projections of lines and planes
CO3: Draw orthographic projections of solids
CO4: Draw development of the surfaces of objects.
CO5: Draw isometric and perspective views of simple solids.

TEXT BOOKS:

1. Bhatt, N. D.,Panchal V M and Pramod R. Ingle, "Engineering Drawing", Charotar Publishing House, 53rd Edition, 2014.
2. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press, 2015

REFERENCES:

1. Agrawal, B. and Agrawal C.M., "Engineering Drawing", Tata McGraw, N.Delhi, 2008.
2. Gopalakrishna, K. R., "Engineering Drawing", Subhas Stores, Bangalore, 2007.
3. Natarajan, K. V., "A text book of Engineering Graphics", 28th Ed., Dhanalakshmi Publishers, Chennai, 2015.
4. Shah, M. B., and Rana, B. C., "Engineering Drawing", Pearson, 2nd Ed., 2009.
5. Venugopal, K. and Prabhu Raja, V., "Engineering Graphics", New Age,2008.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.

4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only.
4. The students will be permitted to use appropriate scale to fit solution within A3 size.
5. 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	PSO 1	PSO 2	PSO 3
CO105.1	3	3	3	3	3	3			1		2	3			
CO105.2	3	3	3	3	3	3			1		2	3			
CO105.3	3	3	3	3	3	3			1		2	3			
CO105.4	3	3	3	3	3	3			1		2	3			
CO105.5	3	3	3	3	3	3			1			3			
CO105	3	3	3	3	3	3			1		2	3			

BS5161	BASIC SCIENCES LABORATORY (Common to all branches of B.E. / B.TechProgrammes)	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY: (Any Seven Experiments)

OBJECTIVE

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

LIST OF 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. Photoelectric effect
14. Michelson Interferometer.
15. Estimation of laser parameters.
16. Melde's string experiment

TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

CO1: To determine various moduli of elasticity.

CO2: To determine the velocity of ultrasonic waves, band gap determination

CO3: To determine various thermal and optical properties of materials.

CO4: To determine the viscosity of liquids

CO5: To determine the estimation of laser parameters

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	PSO 1	PSO 2	PSO 3
CO106.1	3	3	3	3	3										
CO106.2	3	3	3	3	3										
CO106.3	3	3	3	3	3										
CO106.4	3	3	3	3	3										
CO106.5	3	3	3	3	3										
CO106	3	3	3	3	3										

CHEMISTRY LABORATORY: (Minimum of 8 experiments to be conducted)

OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electro analytical techniques such as, pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and polymers by spectroscopy and viscometry methods

LIST OF EXPERIMENTS:

1. Estimation of HCl using Na2CO3 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 argent metric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Estimation of iron content of the water sample using spectrophotometer (1, 10-Phenanthroline / thiocyanate method).
10. Estimation of sodium and potassium present in water using flame photometer.
11. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
12. Pseudo first order kinetics-ester hydrolysis.
13. Corrosion experiment-weight loss method.
14. Phase change in a solid.

TOTAL: 30 PERIODS

OUTCOMES:

- To analyze the quality of water samples with respect to their acidity, alkalinity,

hardness and DO

- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To determine the molecular weight of polymers by viscometric method
- To quantitatively analyze the impurities in solution by electro analytical techniques
- To design and analyze the kinetics of reactions and corrosion of metals

TEXTBOOKS:

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

GE5162	WORKSHOP PRACTICES LABORATORY **(Common to all Branches of B.E. / B.Tech. Programmes)**	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES 1 5

PLUMBING WORK:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
b) Preparing plumbing line sketches.
c) Laying pipe connection to the suction side of a pump
d) Laying pipe connection to the delivery side of a pump.
e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

a) Sawing,
b) Planning and
c) Making joints like T-Joint Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:

a) Completion joints in door panels and wooden furniture
b) Completion common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES 15

WIRING WORK:

a) Wiring Switches, Fuse, Indicator and Lamp etc. such as in basic household,
b) Wiring Stair case light.
c) Wiring tube – light.
d) Preparing wiring diagrams for a given situation.Wiring Study:
a) Completion an Iron-Box wiring.
b) Completion a Fan Regulator wiring.
c) Completion an Emergency Lamp wiring.

GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES **15**

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:
a) (simple)Turning.
b) (simple)Drilling.
c) (simple)Tapping.

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.
c) Assembling an air conditioner.

SHEET METAL WORK:

a) Making of a square tray

FOUNDRY WORK:

a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES **15**

SOLDERING WORK:
a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

a) Completion a FM radio.
b) Completion an electronic telephone.

TOTAL (P: 60) = 60 PERIODS

COURSE OUTCOMES:

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

CO1: Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2: Wire various electrical joints in common household electrical wire work.

CO3: Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipment; Make a tray out of metal sheet using sheet metal work.

CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

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	PSO 1	PSO 2	PSO 3
CO107.1	3	3	3	3	3				2		1				
CO107.2	3	3	3	3	3				2		1				
CO107.3	3	3	3	3	3				2		1				
CO107.4	3	3	3	3	3				2		1				
CO107	3	3	3	3	3				2		1				

SEMESTER II

MA5252	ENGINEERING MATHEMATICS – II (Common to all Branches of B.E. / B.Tech. Programmes)	L	T	P	C
		3	1	0	4

OBJECTIVES:

- To acquaint the students with the concepts of vector calculus which naturally arises in many engineering problems.
- To develop an understanding of the standard techniques of complex variable theory in particular analytic function and its mapping property.
- To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.
- To acquaint the students with Differential Equations which are significantly used in engineering problems.
- 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.

UNIT I 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 theorem, Stoke's theorem and Gauss divergence theorem – Verification and application in evaluating line, surface and volume integrals.

UNIT II ANALYTIC FUNCTION 12

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

UNIT III 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 IV DIFFERENTIAL EQUATIONS 12

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

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:

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

CO1: Calculate grad, div and curl and use Gauss, Stokes and Greens theorems to simplify calculations of integrals.

CO2: Construct analytic functions and use their conformal mapping property in application problems.

CO3: Evaluate real and complex integrals using the Cauchy's integral formula and residue theorem.

CO4: Apply various methods of solving differential equation which arise in many application problems.

CO5: Apply Laplace transform methods for solving linear differential equations.

TEXTBOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2015.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), 7th Edition, New Delhi, 2009.
2. Glyn James, "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, New Delhi, 2011.
3. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, New Delhi, 2017.
4. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, 7th Edition, New Delhi, 2012.
5. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Co. Ltd., 11th Reprint, New Delhi, 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	PSO 1	PSO 2	PSO 3
CO108.1	3	3	3	3	3				1			3			
CO108.2	3	3	3	3	3				1			3			
CO108.3	3	3	3	3	3				1			3			
CO108.4	3	3	3	3	3				1			3			
CO108.5	3	3	3	3	3				1			3			
CO108	3	3	3	3	3				1			3			

PH5252	PHYSICS FOR ELECTRONIC SCIENCES (Common to EEE and EI Branches)	L	T	P	C
		3	0	0	3

OBJECTIVE

- To make the students to understand the basics of crystallography and its importance in completion materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instill knowledge on physics of semiconductors, determination of charge carriers and device applications
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I CRYSTALLOGRAPHY **9**

Crystal structures Bravais lattices – packing factor of SC, BCC, FCC, HCP and diamond structures – Close-packed crystal directions and planes – Surface crystallography – surface structure for BCC and close packed structures - surface to volume ratio: plane, cylinder, cube, sphere Number of atoms and number of surface atoms in a structure: unit cell approach imperfections and impurities.

UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS **9**

Classical free electron theory Expression for electrical conductivity – Thermal conductivity, expression Quantum free electron theory : Tunneling – degenerate states – Fermi- Dirac statistics – Density of energy states – Electron in periodic potential – Energy bands in solids – tight binding approximation Electron effective mass – concept of hole. Ferromagnetism: origin and exchange interaction- saturation magnetization and curie temperature – Domain Theory- M versus H behaviour– Hard and soft magnetic materials.

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS **9**

Intrinsic Semiconductors – Energy band diagram – direct and indirect band gap semiconductors – Carrier concentration in intrinsic semiconductors – extrinsic semiconductors Carrier concentration in N-type & P-type semiconductors – Variation of carrier concentration with temperature – Carrier transport in Semiconductors: Drift, mobility and diffusion – Hall effect and devices – Ohmic contacts – Schottky diode.

UNIT IV OPTICAL PROPERTIES OF MATERIALS **9**

Classification of optical materials – Absorption emission and scattering of light in metals, insulators & Semiconductors LED's – Organic LED's – Plasma light emitting devices – LCD's – Laser diodes – Optical data storage techniques (including DVD, Blue ray disc, Holographic data storage).

UNIT V NANO DEVICES **9**

Electron density in a conductor – Significance between Fermi energy and volume of the material – Quantum confinement – Quantum structures – Density of states for quantum wells, wires and dots – Band gap of nanomaterials –Tunneling – Single electron phenomena – Single electron Transistor. Conductivity of metallic nanowires – Ballistic transport – Quantum resistance and conductance – Carbon nanotubes: Properties and applications Transport of spin – Spintronic devices and applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Know basics of crystallography and its importance for materials properties

CO2: Come to have firm knowledge on the electrical and magnetic properties of materials and their

applications

CO3: Acquire adequate understanding of semiconductor physics and functioning of semiconductor devices

CO4: Understand the optical properties of materials and working principles of various optical devices

CO5: Appreciate the importance of nanotechnology, physics of nano devices, low-dimensional structures and their applications

REFERENCES

1. W.D.Callitser and D.G.Rethwish. Materials Science and Engineering. John Wiley & Sons, 2014.
2. S.O. Kasap. Principles of Electronic Materials and Devices. McGraw Hill Education, 2017.
3. R.F.Pierret. Semiconductor Device Fundamentals. Pearson, 2006.
4. N.Garcia, A. Damask and S.Schwarz. Physics for Computer Science Students. Springer-Verlag, 2012.
5. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education, 2009.
6. J.Wilson and J.F.B.Hawkes. Optoelectronics. Pearson Education, 2018.
7. N.Gershenfeld. The Physics of Information Technology. Cambridge University Press, 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	PSO 1	PSO 2	PSO 3
CO109.1	3	3	3	3	3				1		1				
CO109.2	3	3	3	3	3				1		1				
CO109.3	3	3	3	3	3				1		1				
CO109.4	3	3	3	3	3				1		1				
CO109.5	3	3	3	3	3				1		1				
CO109	3	3	3	3	3				1		1				

GE5152	ENGINEERING MECHANICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Applying the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.
2. Applying the concept of reaction forces (non-concurrent coplanar and non coplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.
3. Applying the concepts of locating centroids/center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.
4. Applying the concepts of frictional forces at the contact surfaces of various engineering systems.
5. Applying the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

UNIT I STATICS OF PARTICLES (9+3)

Fundamental Concepts and Principles, Systems of Units, Method of Problem Solutions, Statics of Particles -Forces in a Plane, Resultant of Forces, Resolution of a Force into Components, Rectangular Components of a Force, Unit Vectors. Equilibrium of a Particle- Newton's First Law of

Motion, Space and Free-Body Diagrams, Forces in Space, Equilibrium of a Particle in Space.

UNITII EQUILIBRIUM OF RIGID BODIES (9+3)

Principle of Transmissibility, Equivalent Forces, Vector Product of Two Vectors, Moment of a Force about a Point, Varignon's Theorem, Rectangular Components of the Moment of a Force, Scalar Product of Two Vectors, Mixed Triple Product of Three Vectors, Moment of a Force about an Axis, Couple - Moment of a Couple, Equivalent Couples, Addition of Couples, Resolution of a Given Force into a Force -Couple system, Further Reduction of a System of Forces, Equilibrium in Two and Three Dimensions - Reactions at Supports and Connections.

UNITIII DISTRIBUTED FORCES (9+3)

Centroids of lines and areas – symmetrical and unsymmetrical shapes, Determination of Centroids by Integration , Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies , Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration , Polar Moment of Inertia , Radius of Gyration of an Area , Parallel- Axis Theorem , Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates , Determination of the Moment of Inertia of a Three-Dimensional Body by Integration

UNIT IV FRICTION (9+3)

The Laws of Dry Friction. Coefficients of Friction, Angles of Friction, Wedges, Wheel Friction. Rolling Resistance, Ladder friction.

UNITV DYNAMICS OF PARTICLES (9+3)

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles. Kinetics- Newton's Second Law of Motion -Equations of Motions, Dynamic Equilibrium, Energy and Momentum Methods - Work of a Force , Kinetic Energy of a Particle, Principle of Work and Energy, Principle of Impulse and Momentum, Impact, Method of Virtual Work - Work of a Force, Potential Energy, Potential Energy and Equilibrium.

TOTAL (L: 45 + T: 15) =60 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the various methods to determine the resultant forces and its equilibrium acting on a particle in 2D and 3D.

CO2: Apply the concept of reaction forces (non-concurrent coplanar and noncoplanar forces) and moment of various support systems with rigid bodies in 2D and 3D in equilibrium. Reducing the force, moment, and couple to an equivalent force - couple system acting on rigid bodies in 2D and 3D.

CO3: Apply the concepts of locating centroids / center of gravity of various sections / volumes and to find out area moments of inertia for the sections and mass moment of inertia of solids.

CO4: Apply the concepts of frictional forces at the contact surfaces of various engineering systems.

CO5: Apply the various methods of evaluating kinetic and kinematic parameters of the rigid bodies subjected to concurrent coplanar forces.

TEXT BOOKS:

1. Beer Ferdinand P, Russel Johnston Jr., David F Mazurek, Philip J Cornwell, SanjeevSanghi, Vector Mechanics for Engineers: Statics and Dynamics, McGraw Higher Education., 11th Edition, 2017.
2. Vela Murali, "Engineering Mechanics-Statics and Dynamics", Oxford University Press, 2018.

REFERENCES:

1. Boresi P and Schmidt J, Engineering Mechanics: Statics and Dynamics, 1/e, Cengage learning, 2008.
2. Hibbeller, R.C., Engineering Mechanics: Statics, and Engineering Mechanics: Dynamics, 13th

edition, Prentice Hall, 2013.
3. Irving H. Shames, Krishna Mohana Rao G, Engineering Mechanics – Statics and Dynamics, 4th Edition, Pearson Education Asia Pvt. Ltd., 2005.
4. Meriam J L and Kraige L G, Engineering Mechanics: Statics and Engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Timoshenko S, Young D H, Rao J V and Sukumar Pati, Engineering Mechanics, 5thEdition, McGraw Hill Higher Education, 2013.

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	PSO 1	PSO 2	PSO 3
CO110.1	3	3	3	2	3				1		1				
CO110.2	3	3	3	2	3				1		1				
CO110.3	3	3	3	2	3				1		1				
CO110.4	3	3	3	2	3				1		1				
CO110.5	3	3	3	2	3				1		1				
CO110	3	3	3	2	3				1		1				

GE5153	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:
- To know the basics of algorithmic problem solving.
- To develop Python programs with conditionals and loops.
- To define Python functions and use function calls.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

UNIT I INTRODUCTION TO COMPUTING AND PROBLEM SOLVING 9

Fundamentals of Computing – Computing Devices – Identification of Computational Problems – Pseudocodes and Flowcharts – Instructions – Algorithms – Building Blocks of Algorithms – Introduction to Python Programming – Python Interpreter and Interactive Mode – Variables and Identifiers – Arithmetic Operators– Values and Types – Statements.

Suggested Activities:
- Developing Pseudocodes and flowcharts for real life activities such as railway ticket booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic operations.
- Installing Python.
- Simple programs on print statements, arithmetic operations.

Suggested Evaluation Methods:
- Assignments on pseudocodes and flowcharts.
- Tutorials on Python programs.

UNIT II CONDITIONALS AND FUNCTIONS 9

Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If-Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement

– Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions.

Suggested Activities:
- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions.
- Implementation of a simple calculator.
- Developing simple applications like calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and iterative statements.
- External learning Recursion vs. Iteration.

Suggested Evaluation Methods:
- Tutorials on the above activities.
- Group Discussion on external learning.

UNIT III SIMPLE DATA STRUCTURES IN PYTHON 10

Introduction to Data Structures – List – Adding Items to a List – Finding and Updating an Item – Nested Lists – Cloning Lists – Looping Through a List – Sorting a List – List Concatenation – List Slices – List Methods – List Loop – Mutability – Aliasing – Tuples: Creation, Accessing, Updating, Deleting Elements in a Tuple, Tuple Assignment, Tuple as Return Value, Nested Tuples, Basic Tuple Operations – Sets.

Suggested Activities:
- Implementing python program using lists, tuples, sets for the following scenario: Simple sorting techniques Student Examination Report Billing Scheme during shopping.
- External learning List vs. Tuple vs. Set – Implementing any application using all the three data structures.

Suggested Evaluation Methods:
- Tutorials on the above activities.
- Group Discussion on external learning component.

UNIT IV STRINGS, DICTIONARIES, MODULES 10

Strings: Introduction, Indexing, Traversing, Concatenating, Appending, Multiplying, Formatting, Slicing, Comparing, Iterating – Basic Built-In String Functions – Dictionary: Creating, Accessing, Adding Items, Modifying, Deleting, Sorting, Looping, Nested Dictionaries Built-in Dictionary Function – Finding Key and Value in a Dictionary – Modules – Module Loading and Execution – Packages – Python Standard Libraries.

Suggested Activities:
- Implementing Python program by importing Time module, Math package etc.
- Creation of any package (student's choice) and importing into the application.

Suggested Evaluation Methods:
- Tutorials on the above activities.

UNIT V FILE HANDLING AND EXCEPTION HANDLING 7

Introduction to Files – File Path – Opening and Closing Files – Reading and Writing Files – File Position – Exception: Errors and Exceptions, Exception Handling, Multiple Exceptions.

Suggested Activities:
- Developing modules using Python to handle files and apply various operations on files.
- Usage of exceptions, multiple except blocks for applications that use delimiters like age, range of numerals etc.

- Implementing Python program to open a non-existent file using exceptions.

Suggested Evaluation Methods:
- Tutorials on the above activities.
- Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOK:

1. Reema Thareja, "Python Programming using Problem Solving Approach", Oxford University Press, 2017.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Shroff/O'Reilly Publishers, 2016. (http://greenteapress.com/wp/thinkpython/).

REFERENCES:

1. Guido van Rossum, Fred L. Drake Jr., "An Introduction to Python – Revised and Updated for Python 3.2", Network Theory Ltd., 2011.
2. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and Expanded Edition, MIT Press , 2013
3. Charles Dierbach, "Introduction to Computer Science using Python", Wiley India Edition, 2016.
4. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
5. Kenneth A. Lambert, "Fundamentals of Python: First Programs", Cengage Learning, 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	PSO 1	PSO 2	PSO 3
CO111.1	3	3	3	3	3						3	3			
CO111.2	3	3	3	3	3						3	3			
CO111.3	3	3	3	3	3						3	3			
CO111.4	3	3	3	3	3						3	3			
CO111.5	3	3	3	3	3						3	3			
CO111.6	3	3	3	3	3						3	3			
CO111	3	3	3	3	3						3	3			

EI5201	ELECTRONICS FOR ANALOG SIGNAL PROCESSING - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I SEMICONDUCTOR DEVICES 9

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.

UNIT II BJT AMPLIFIERS AND POWER DEVICES 9

BJT: NPN and PNP transistors, Characteristics of CE, CB and CC amplifier configurations, Biasing circuits, Small Signal analysis of BJT amplifier, Frequency response of BJT amplifier, Gain-Bandwidth product – Transistor switching circuits - Thyristors: Characteristics and applications of SCR, DIAC and TRIAC.

UNIT III FET AMPLIFIERS 9

FET: JFET and MOSFET, Characteristics of CS, CG and CD amplifier configurations – Biasing circuits– Small signal analysis of FET amplifier, Frequency response of FET amplifiers - CMOS inverter circuits, IGBT and IGFET.

UNIT IV MULTISTAGE AND FEEDBACK AMPLIFIERS 9

Multistage amplifier: Coupling schemes for cascading amplifier, General analysis of N-stage cascaded amplifier, Darlington pair, Cascade and Bootstrap amplifiers. Feedback amplifier: Advantages of negative feedback, Mixing and Sampling networks – Types and effects, VoltageSeries, Voltage-Shunt, Current-Series and Current-Shunt amplifier circuits. Introduction to Tuned Amplifiers.

UNIT V OSCILLATORS AND POWER AMPLIFIERS 9

Oscillators: Classification, Condition for oscillation - RC 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 : 45 PERIODS

COURSE OUTCOMES (COs)

1. Be able to gain knowledge on the operation and characteristics of different semi-conductor devices.
2. Ability to design an application of semi-conductor devices under various conditions.
3. To develop competence in frequency response analysis and biasing techniques to operate BJT and FET in different configurations.
4. Be able to develop analytical capability to examine feedback in amplifiers
5. Develop the design competence in the area of multistage amplifiers.
6. To make the students understand the concept of various power amplifiers and tuned amplifiers.
7. Be able to design transistor amplifiers and oscillators for a given conditions.

TEXT BOOKS:

1. Jacob Millman, Christos C. Halkias, Satyabrata Jit, "Electronic Devices and Circuits", 4th Edition, McGraw Hill, 2017.
2. Donald A. Neaman, "Electronic Circuits Analysis and Design", 3rd Edition, Tata McGraw Hill, 2008.
3 Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, 11th edition, Pearson Education, 2015.

REFERENCE BOOKS:

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, 2015.
4. Donald A. Neaman, "Semiconductor Physics and Devices Basic Principles", 3rd Edition, McGraw Hill, 2012.
5. 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	PSO 1	PSO 2	PSO 3
CO112.1	3	2	2	1	3	1		1	1	2		2		2	
CO112.2	3	3	3	2	3	1		1	1	2		2		2	
CO112.3	3	2	2	1	3			1	1	2		2		2	
CO112.4	3	2	2	2	3	1		1	1	2		2		2	
CO112.5	3	2	2	1	2			1	1	2		2		2	
CO112.6	3	2	2		2	1		1	1	2		2		2	
CO112.7	3	2	3	3	3	1		1	1	2		2		2	
CO112	3	2.1	2.3	1.7	2.7	1		1	1	2		2		2	

GE5161	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To articulate where computing strategies support in providing Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same.
2. Python programming using simple statements and expressions.
3. Scientific problems using Conditionals and Iterative loops.
4. Implementing real-time/technical applications using Lists, Tuples.
5. Implementing real-time/technical applications using Sets, Dictionaries.
6. Implementing programs using Functions.
7. Implementing programs using Strings.
8. Implementing programs using written modules and Python Standard Libraries.

9. Implementing real-time/technical applications using File handling.
10. Implementing real-time/technical applications using Exception handling.
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Structure simple Python programs for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python data structures.
CO6: Apply Python features in developing software applications.

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	PSO 1	PSO 2	PSO 3
CO113.1	3	3	3	3	3						3	3			
CO113.2	3	3	3	3	3						3	3			
CO113.3	3	3	3	3	3						3	3			
CO113.4	3	3	3	3	3						3	3			
CO113.5	3	3	3	3	3						3	3			
CO113.6	3	3	3	3	3						3	3			
CO113	3	3	3	3	3						3	3			

EI5211	ANALOG SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To facilitate the students to study the characteristics of various semiconductor devices.
- To provide practical knowledge on the analysis of rectifiers, regulators, amplifiers and oscillators.
- To enable the students to design rectifiers, regulators, amplifiers and oscillators for a given set of specifications.
- 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. PN junction diode characteristics and application as a rectifier.
3. Determination of characteristics of BJT amplifier in CE configuration and determination of h-parameters.
4. Determination of characteristics of JFET amplifier in CS configuration and determination of amplification factor.
5. Determination of characteristics of UJT and application as a relaxation oscillator.
6. Determination of characteristics of SCR and application as a controlled rectifier.
7. Design and verification 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 and verification of cascaded CE amplifier.

10. Design and verification of Wien Bridge oscillator and Colpitts oscillator circuits.
11. Design and verification of series and shunt voltage regulators.
12. Simulation of at least four of the above experiments using e-CAD tools.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

1. To make the students understand the concept of various instruments and meters for measurement of electrical quantities.
2. Ability to identify the operational characteristics of semiconductor devices like Diode, BJT, FET, SCR and UJT through experimentation.
3. Ability to demonstrate different applications of diode, UJT and SCR with measuring instruments and power supplies.
4. Ability to design and experiment with various voltage regulation circuits, multistage amplifier and oscillators
5. Ability to use appropriate software tools for design, analysis and implementation of various application circuits.
6. Ability to construct, analyze and troubleshoot the designed circuits.
7. Ability to interpret the results of analysis and depict the significant conclusions.
8. 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	PSO 1	PSO 2	PSO 3
CO114.1	3	1	1		1	1		1	1	2		2			
CO114.2	3	3	3	1	3	1		1	1	2		2			
CO114.3	3	3	3	1	3	1		1	1	2		2			
CO114.4	3	3	2	1	3	1		1	1	2		2			
CO114.5	3		3	3	3	1		1	1	2		2			
CO114.6	3		3	3	2	1		1	2	2		2			
CO114.7	3	2	2	1	1	1		3	2	3		3			
CO114.8	2					1		3	3	3		3			
CO114	2.9	2.4	2.4	1.6	2.3	1		1.5	1.7	2.3		2.3			

MA5356	LINEAR ALGEBRA AND NUMERICAL METHODS	L	T	P	C
		3	1	0	4

OBJECTIVES:

The basic concepts and tools of the subject covered are:

- Vector spaces and subspaces; linear independence and span of a set of vectors, basis and dimension; the standard bases for common vector spaces;
- Linear maps between vector spaces, their matrix representations, null-space and Range spaces, the Rank- Nullity Theorem;
- Inner product spaces: Cauchy-Schwarz inequality, orthonormal bases, the Gramm-Schmidt procedure, orthogonal complement of a subspace, orthogonal projection;
- Eigenvalues and eigenvectors, diagonalizability of a real symmetric matrix, canonical forms;
- Mathematical foundations of numerical techniques for solving linear systems, eigenvalue problems and generalized inverses.

UNIT I VECTOR SPACES 12

Vector spaces – Subspaces – Linear combinations - Linear Span – Linear dependence - Linear independence – Bases and Dimensions

UNIT II LINEAR TRANSFORMATIONS 12

Linear Transformation – Null space, Range space - dimension theorem - Matrix and representation of Linear Transformation – Eigen values Eigenvectors of linear transformation – Diagonalization of linear transformation – Application of diagonalization in linear system of differential equations.

UNIT III INNER PRODUCT SPACES 12

Inner Products and norms - Inner Product Spaces - Orthogonal vectors – Gram Schmidt orthogonalization process – Orthogonal complement – Least square Approximations

UNIT IV NUMERICAL SOLUTION OF LINEAR SYSTEM OF EQUATIONS 12

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

UNIT V NUMERICAL SOLUTION OF EIGENVALUE PROBLEMS AND ENERALISED INVERSES 12

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

TOTAL: 60 PERIODS

OUTCOMES:

1. The students will be 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. Analyze and evaluate the accuracy of common numerical methods.

TEXT BOOKS:

1. Faires, J.D. and Burden, R., "Numerical Methods", Brooks/Cole (Thomson Publications), 4th Edition, New Delhi, 2012.
2. Friedberg, S.H., Insel, A.J. and Spence, E., "Linear Algebra", Pearson Education, 5th Edition, New Delhi, 2008.
3. Williams, G, "Linear Algebra with Applications", Jones & Bartlett Learning, First Indian Edition, New Delhi, 2019.

REFERENCES:

1. Bernard Kolman, David R. Hill, "Introductory Linear Algebra", Pearson Education, First Reprint, New Delhi, 2010.
2. Gerald, C.F, and Wheatley, P.O., "Applied Numerical Analysis", Pearson Education, 7th Edition, New Delhi, 2004.
3. Kumaresan, S., "Linear Algebra – A geometric approach", Prentice – Hall of India, Reprint, New Delhi, 2010.
4. Richard Branson, "Matrix Operations", Schaum's outline series, McGraw Hill, New York, 1989.
5. Strang, G., "Linear Algebra and its Applications", Cengage Learning, New Delhi, 2005.
6. Sundarapandian. V, "Numerical Linear Algebra", Prentice – Hall of India, New Delhi, 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
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
Average	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

PR5301	THERMODYNAMICS AND FLUID MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To make students understand the basic laws of thermodynamics.
2. To make the students to familiarize with the concepts, laws and methodologies for the analysis of gas turbines and compressors.
3. To introduce the basic concepts of fluid mechanics.
4. To make students understand 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.

UNIT II INTRODUCTION TO APPLICATIONS OF THERMODYNAMICS 9

Air standard cycles – Thermodynamics assumption – Otto cycle, diesel cycle and Brayton cycle (air 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.

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.

REFERENCE BOOKS:

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 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO202.1	2	3	3			3		1		1		2	3		
CO202.2	2	3	3			3		1		1		2	3		
CO202.3	3		3					1		1		2	3		
CO202.4			3					1		1					
CO202.5															
CO202	2.3	3	3			3		1		1		2	3		

EI5301	ANALYSIS OF ELECTRIC CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce basic concepts of AC and DC circuits and to explore the basics of R,L, C circuits.
- To introduce various network theorems.
- To introduce the concept of transient analysis of first and second order linear circuits.
- To make the students understand the concept of resonance in Series and Parallel circuits.
- 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 9

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 9

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 9

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 9

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 gparameters.

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 large scale networks.
6. Ability to Identify, formulate, and solve engineering problems in the area circuits and systems.

TEXT BOOKS:

1. Robert L.Boylsted, R.L., "Introductory Circuit Analysis", 13th Edition, Prentice Hall, 2016
2. Alexander, C.K., Matthew, N.O., and Sadiku, "Fundamentals of Electric Circuits", McGraw- Hill, 2007.

REFERENCE BOOKS:

1. Edminister, J.A. and Nahvi, M., "Electric Circuits", 7thEdition, Schaum's Outline series, McGraw-Hill, 2018.
2. HAYT, Jr.W.H.,Kemmerly, J.E., and Durbin, S.M., "Engineering Circuit Analysis", 8thedition,McGraw-Hill, 2007.
3. Decarlo, R.A. and Lin, P.M., "Linear Circuit Analysis", 2ndEdition,Oxford University Press, 2001

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	3	2	1	2	1					1	2	1	2	
CO203.2	3	3	3	2	2	1					1	2		2	
CO203.3	3	2	3	2	2	1					1	2		2	
CO203.4	3	2	3	2	2	1					1	2		2	
CO203.5	2	1	1	1	3	1					1	3		2	
CO203.6	3	3	3	2	2	1					1	2		1	
CO203	2.8	2.3	2.5	1.6	2.16	1					1	2.16	1	1.8	

EI5302	ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart basic knowledge on different AC& DC Machines.
- To introduce the concept of special machines to motivate the students to solve complex problems related to machines.
- To impart knowledge on testing and controlling of different machines.
- Make the students familiar with the testing and controlling of different machines.

UNIT I 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 II TRANSFORMERS **9**

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 III THREEPHASE INDUCTION MOTOR **9**

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

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 – V curves, 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 , Hysteresis motor ,Permanent magnet synchronous motor, Introduction to stepping motors- Switched reluctance motor .

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to Remember and understand Terms, basic concepts and working principle of electrical machines.
2. Apply the Knowledge of Basic Concepts and Working Principles to carry out Test on Electrical Machines.
3. Ability to understand and Interpret the performance characteristics of machines
4. Ability to identify suitable machines for carrying out interdisciplinary projects.
5. Ability to apply the knowledge on various machines to choose appropriate machines for specific application useful for society.
6. Ability to understand the working principle 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, 2003. 6th Edition.
2. Theraja, B.L., “A Text book of Electrical Technology”, Vol.II, S.C Chand and Co., New Delhi, 2007

REFERENCE BOOKS:

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. 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
CO204.1	3							1		1			2		
CO204.2	3	3						1		1			2		
CO204.3	3	3						1		1			2		
CO204.4	3	2	1	1				1	3	1			2		
CO204.5	3	2	1	1		3	3	1		1		2	2		
CO204.6	3							1		1		3	2		
CO204	3	2.5	1	1		3	3	1	3	1		2.5	2		

EI5303	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I INTRODUCTION TO CONTINUOUS TIME AND DISCRETE TIME SIGNALS AND SYSTEMS 9

Definition of Continuous Time(CT) and Discrete Time(DT) signals, Representation of signals: – Impulse, Pulse, Step, Ramp, Exponential, Sinusoidal. Classification of signals: – periodic and a-periodic, power and energy, deterministic and random signals. Definition of system: Classification and characterization with examples: – Static & dynamic, causal & non causal, linear & non linear, time variant & time invariant, stable & unstable, FIR & IIR.

UNIT II DISCRETIZATION AND SIGNAL RECONSTRUCTION 9

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

UNIT III ANALYSIS OF CONTINUOUS TIME AND DISCRETE TIME SIGNALS AND SYSTEMS IN TIME DOMAIN 9

LTI system – Convolution – Properties of convolution - Continuous Time systems – Differential equations – Discrete Time systems –Discrete convolution – Difference equations– Impulse response and step response of Continuous Time and Discrete Time systems – Recursive and Non recursive systems.

UNIT IV TRANSFORM DOMAIN ANALYSIS OF CONTINUOUS TIME SYSTEMS 9

Fourier Series representation of signals – Continuous Time Fourier Series(CTFS) – Fourier Transform – Continuous Time Fourier Transform(CTFT) – Definition, Existence and properties - Fourier Transform analysis of Continuous Time signals and systems – Laplace transform analysis of Continuous Time systems – Stability – Causality.

UNIT V TRANSFORM DOMAIN ANALYSIS OF 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 Discrete Time systems using Z Transforms: – Stability, Causality.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

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

1. Ability to understand the characteristics and classifications of CT and DT signals and Systems
2. Ability to understand the sampling and reconstruction of signals
3. Ability to apply the mathematical tools for characterizing various CT and DT signals and Systems in time domain
4. Ability to analyze the given CT signal or system in transform domain
5. Ability to analyze the given DT signal or system in transform domain
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. Arun K Tangirala, Principles of system identification, CRC press 2017.
3. Tarun Kumar Rawat, Signals and Systems, Oxford University Press,2010.

REFERENCE BOOKS:

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,2013.

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	PSO 1	PSO 2	PSO 3
CO205.1	3	3		1	1							1			
CO205.2	2	2		1	1	1						1	3		
CO205.3	3	2		1	3							2		3	
CO205.4	2	3		2	2							1			
CO205.5	2	2	1	2	2		1					1			1
CO205.6	3	3	3	3	3	2						3	3	3	1
CO205	2.5	2.5	2	1.7	2	1.5	1					1.5	3	3	1

EI5311	CIRCUIT SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To learn and practice generation of continuous and discrete time signals
- To analyze time and frequency response of continuous time and discrete time systems
- To study the effect of discretization of continuous time signal
- To simulate various network theorems using simulation software.
- To get introduced to self and mutual inductances
- To introduce power measurement in three phase circuits, z,y and h parameters of a two port network

LIST OF EXPERIMENTS

1. Generation of Continuous Time(CT) and Discrete Time (DT) signals using Simulation software

2. Determine the time response and frequency response of CT system
3. Determine the time response and frequency response of DT system
4. Study the effects of Sampling and quantization on the response of the system
5. Analyze the statistical parameters of random signals
6. Verification of Kirchhoff's laws, Thevenin's and Norton's theorems.
7. Verification of Superposition, Maximum Power transfer and Reciprocity theorems.
8. Analyze and interpret the Time response of RL, RC and RLC circuits for step input.
9. Analyze and interpret the frequency response of Series and Parallel resonance circuits.
10. Determination of self, mutual inductances and coupling coefficient of coupled coils.
11. Power and power factor measurements 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 (COs)

1. Ability to apply the first principle mathematical models to generate and characterize continuous and discrete time signals and systems
2. Ability to analyze the characteristics of random signals.
3. Ability to familiarize simulation software to verify the network theorems and analyze electrical network
4. Ability to design coupled circuit based on input and output signals
5. Ability to Identify the type of load using two-wattmeter method
6. Ability to develop z, y and h parameter model for two port network.

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	PSO 1	PSO 2	PSO 3
CO206.1	3	3			3			1	2	1				3	
CO206.2	3	3		3	3			1	2	1		2		3	
CO206.3	3			2	3			1	2	1		2		3	
CO206.4	3		3	2	3			1	2	1				3	
CO206.5	3		3	3	3			1	2	1				3	
CO206.6	3		3	3	3			1	2	1		2		3	
CO206	3	3	3	2.6	3			1	2	1		2		3	

EI5312	ELECTRICAL MACHINES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To impart the concept of load test and no load test on Electrical Machines.
- To obtain the performance characteristics of Electrical Machines.
- To introduce interfacing of Electrical Machines with Lab VIEW software for data acquisition.
- To impart the knowledge to differentiate electrical and mechanical load.
- To introduce the concept of different methods used for speed control of Electrical Machines.

LIST OF EXPERIMENTS

1. Determination of open circuit and load characteristics of self excited DC generator.
2. Determination of open circuit and load characteristics of separately excited DC generator.
3. Speed control of DC shunt motor by manipulating field and armature parameters.

4. Determining the load characteristics of DC shunt motor using PC based data acquisition system.
5. Determination of load characteristics of DC series motors.
6. Comparison of loading effect on three-phase alternator using DC / AC motors.
7. PC based monitoring and regulation of three- phase alternator.
8. Predetermination of efficiency and regulation of single phase transformer.
9. Load test on single phase transformer.
10. Analysis of loading effect on three phase induction motor using three phase alternator.
11. Load test on single phase induction motor.
12. V curves of synchronous motor for different load conditions.
13. Speed control of DC shunt motor using integrated DC and AC drives.

TOTAL : 60 PERIODS

COURSE OUTCOMES (COs)

The students will be able to:

1. Ability to understand the concept of no load and full load tests on static and Dynamic electrical machines.
2. Ability to realize the concept of mechanical load and electrical load.
3. Ability to obtain the characteristics of any electrical machines.
4. Ability to interface the machines with Lab view software to monitor the electrical parameters.
5. Ability to understand the concept of using electrical machines as the load.
6. Ability to communicate efficiently the engineering facts and function actively and efficiently as an individual or in a team.

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	PSO 1	PSO 2	PSO 3
CO207.1	3	2		3	2			1	1	1			2		
CO207.2	3			1	2			1	1	1			2		
CO207.3	3	2		2	2			1	1	1			2		
CO207.4	3		3	3	3			1	1	1		2	2		
CO207.5	3		3	1	2			1	1	1			2		
CO207.6	3				2			1	3	1	3		2		
CO207	3	2	3	1.6	2.17			1	1.3	1	3	2	2		

GE5251	ENVIRONMENTAL SCIENCES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection.
- To inculcate the effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.

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 – bio geographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 8

Definition - causes,effects and control measures of:(a)Airpollution(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 47 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 protection act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- 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:

1. To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
2. To identify the causes, effects and environmental pollution and natural disasters and contribute to the preventive measures in the immediate society.

3. To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
4. To recognize different forms of energy and apply them for suitable applications in for technological advancement and societal development.
5. To demonstrate the knowledge of societal activity on the long and short term environmental issues and abide by the legal provisions, National and International laws and conventions in professional and personal activities and to identify and analyze effect of population dynamics on human value education, consumerism and role of technology in environmental issues.

TEXT BOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers (2018).
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2016).
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).

REFERENCE BOOKS:

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).
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. (2013).

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	PSO 1	PSO 2	PSO 3
CO208.1	2					3	3	2		1	1	2	2		
CO208.2	2					3	3	2		1	1	2	2		
CO208.3	2					3	3	2		1	1	2	2		
CO208.4	2					3	3	2		1	1	2	2		
CO208.5	2					3	3	2		1	1	2	2		
CO208	2					3	3	2		1	1	2	2		

EI5401	ELECTRONICS FOR ANALOG SIGNAL PROCESSING - II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I OPERATIONAL AMPLIFIERS 9

Differential amplifier: BJT and FET configurations, Differential mode and common mode equivalent circuits, CMRR – OPAMP: Internal blocks, Ideal characteristics, DC and AC characteristics of nonideal OPAMP, Gain Bandwidth Product, Frequency compensation techniques, Methods of improving Slew rate and CMRR, Current Mirror – Inverting and Non-inverting OPAMP configurations.

UNIT II APPLICATIONS OF OPERATIONAL AMPLIFIER 9

Summing and Difference amplifiers, Differentiator and Integrator: ideal and practical circuits, V to I and I to V converters - Clipper and Clamper – Log and Antilog amplifiers, Precision Rectifier, 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

UNIT III TIMER AND PHASE LOCKED LOOP 9

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 9

Analog switches, Sample and hold IC, DAC principle, Resolution, Range – Types: Weighted R, R2R and Inverted R-2R, DAC ICs – ADC: Principle, Types: Flash, sigma-delta convertors Single slope, Dual slope, Successive approximation – ADC ICs.

UNIT V SPECIAL FUNCTION IC'S 9

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 : 45 PERIODS

COURSE OUTCOMES

1. Be able to gain knowledge on the on the fundamentals of operational amplifiers and their characteristics.
2. Ability to develop competence in linear and nonlinear operational amplifiers circuit analysis.
3. Ability to design competence on signal filtering and signal conversion.
4. Be able to design and develop signal conditioning circuits for a specific application
5. Ability to acquire knowledge about the concept and applications of 555 timer IC and PLL
6. Ability to suggest the appropriate A/D and D/A converters for signal processing applications.
7. Be able to understand the concept of power amplifiers, voltage regulators and analog multipliers.

TEXT BOOKS:

1. Ramakant Gayakwad, "Op-amps and Linear Integrated Circuits", 4th Edition, PEARSON, 4thEdition, 2015.
2. Robert F. Coughlin, Frederick F. Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6th Edition, Prentice Hall, 2001.
3. Sergio Franco, "Design with Operational Amplifiers and Linear Integrated Circuits", 3rd Edition, Tata McGraw Hill, 4, 2016.

REFERENCE BOOKS:

1. Paul R. Gray, "Analysis and Design of Analog Integrated Circuits", 5th Edition, Wiley, 2010.
2. Roy Choudury, D., and Shail B. Jain, "Linear Integrated Circuits", 4th, New Age International, 2011.
3. 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	PSO 1	PSO 2	PSO 3
CO209.1	3	1	1	1	3	1		1	1	2		2		2	
CO209.2	3	2	2	2	3	1		1	1	2		2		2	
CO209.3	3	3	3	1	3	1		1	1	2		3		2	
CO209.4	3	3	3	3	3	1		1	1	2		3		2	
CO209.5	3	2	2	1	1	1		1	1	2		2		2	
CO209.6	3	2	2	2		1		1	1	2		2		2	
CO209.7	3	2	2	2	2	1		1	1	2		2		2	
CO209	3	2.1	2.1	1.8	2.5	1		1	1	2		2.3		2	

EI5402	DIGITAL SYSTEM DESIGN	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES

- To study various number systems, Boolean expressions and simplifications.
- To study, analyze and design of the combinational logic circuits for arithmetic operations.
- To study, analyze and design of sequential circuits, registers and counters.
- To study, analyze and design asynchronous sequential circuits and to know the functions of ASM charts.
- 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. Logic Families &their characteristics - DTL,TTL, CMOS, FAN-IN, FAN-OUT.

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. Realization of combinational logic circuits using decoders and multiplexers.

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 –CPLD - FPGA – Hardware Description Language: Introduction - HDL for combinational logic circuits - HDL for Sequential logic circuits.

TOTAL : 45 PERIODS

LIST OF EXPERIMENTS

1. Verification of logic gates and realization of Boolean expressions using gates.
2. Implementation of Combinational logic circuits using MUX and Decoder ICs.
3. Design of code converters, Encoder and Decoder using logic gates
4. Verification of flip-flops and design of Asynchronous Counters, Synchronous Counters and Universal shift registers using flip-flop.
5. Simulation of combinational/sequential logic circuits using HDL and porting the program into FPGA/CPLD.
6. Design of combinational / sequential logic circuit for instrumentation application such as Alarm / Interlock.

TOTAL :30 PERIODS
TOTAL:45+30=75 PERIODS

COURSE OUTCOMES(COs)

1. Ability to apply mathematical knowledge of number systems, Boolean expressions / functions to simplify and realize logical expression ,understand and contrast different logic families
2. Ability to analyze and design combinational logic circuits.
3. Ability to analyze and design sequential logic circuits.
4. Ability to analyze and design synchronous and asynchronous logic circuits
5. Ability to understand memory types and gain knowledge on building blocks of different Programmable Logic devices
6. Ability to solve engineering problems in the area of digital logic circuit.
7. Ability to use appropriate software such as VHDL/Verilog for electronic prototyping and modeling of digital system.
8. Ability to design, implement and demonstrate sequential and combinational logic circuits for instrumentation applications

TEXT BOOKS:

1. Thomas L. Floyd, "Digital Fundamentals", 11th Edition, Prentice Hall, 2015.
2. Donald P Leach, Albert Paul Malvino and GoutamSaha, "Digital Principles and Applications", 8th Edition, McGraw-Hill, 2014.
3. Morris Mano, M. and Michael D. Ciletti, "Digital Design with an Introduction to the Verilog HDL", 5th Edition, Prentice Hall, 2013.

REFERENCE BOOKS:

1. Fundamentals of Logic Design, "Charles H Roth and Larry L KInney", 6th Edition, Cengage Learning, 2013.
2. John F. Wakerly, "Digital Design Principles and Practices", Pearson Education, 2008.
3. NPTEL video lectures on "Digital systems Design", Prof.D. Roychoudhury 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	PSO 1	PSO 2	PSO 3
CO210.1	3	3	2	2	2	1	1	2	2	2	3	3		2	
CO210.2	3	3	3	3	2	1	1	2	2	2	3	3		2	
CO210.3	3	3	3	3	3	1	1	2	2	2	3	3		2	
CO210.4	3	3	3	3	3	1	1	2	2	2	3	3		2	
CO210.5	3	3	2	2	3	1	1	2	2	2	3	3		2	
CO210.6	3	3	3	3	3	1	1	2	2	2	3	3		2	
CO210.7	3	3	3	3	3	1	1	2	2	2	3	3		2	
CO210.8	3	3	3	3	3	1	1	2	2	2	3	3		2	
CO210	3	3	2.75	2.75	2.75	1	1	2	2	2	3	3		2	

EI5403	INSTRUMENT TRANSDUCERS	L	T	P	C
		3	0	0	3

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 CHARACTERISTICS OF TRANSDUCERS 9

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

UNIT II SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

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

UNIT III VARIABLE RESISTANCE TRANSDUCERS 9

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

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TANSDUCERS 9

Inductive transducers: Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – Synchros – Microsyn – Principle of operation, construction details.

Capacitive transducers: Principle of operation, construction details and characteristics– Different types & Signal Conditioning – Applications: Capacitor microphone, Capacitive pressure sensor, Proximity sensor.

UNIT V OTHER TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Fiber optic sensors – Seismic pickup transducers – Introduction to MEMS – Introduction to Smart transducers and its interface standard (IEEE 1451).

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to apply the Mathematical knowledge, basics of Science and Engineering fundamentals to solve the problems pertaining to measurement applications and to perform error analysis and uncertainty analysis.
2. Ability to infer the static and dynamic characteristics of various transducers.
3. Ability to utilize software like Lab VIEW, MATLAB to analyze the characteristics of the behavior of transducers.
4. Ability to understand transduction principles.
5. Ability to suggest a suitable transducer for a given specific application.
6. Ability to design signal conditioning circuits for resistive, inductive and capacitive transducers.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Neubert H.K.P., "Instrument Transducers – An Introduction to their Performance and Design", Oxford University Press, Cambridge, 2005.
2. Albert D. Helfrick and Cooper, W. D., "Modern Electronic Instrumentation and Measurement Techniques", PHI Learning Pvt. Ltd., 2017.
3. Murthy, D.V.S., "Transducers and Instrumentation", 2nd Edition, Prentice Hall of India Pvt.Ltd., New Delhi, 2011.

4. John P. Bentley, "Principles of Measurement Systems", 4th Edition, Pearson Education, 2004.
5. Bolton, W., "Engineering Science", Elsevier Newnes, 2nd Edition, 1994.
6. Patranabis, D., "Sensors and Transducers", 2nd Edition, Prentice Hall of India,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	PSO 1	PSO 2	PSO 3
CO211.1	3	3	3	3	1	2		1		1		1	3	3	
CO211.2	3	3	3	2		1		1		1		1	3	3	
CO211.3	2	2	2		3			1		1		1	3	3	
CO211.4	3							1		1		1	3	3	
CO211.5	3	3	3	3	2	2		1		1		1	3	3	
CO211.6	3	3	3	3	3	1	1	1		1		1	3	3	
CO211	3	2.8	2.8	2.75	2.25	1.5	1	1		1		1	3	3	

EI5404	ELECTRICAL AND ELECTRONICS MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge in the specific area of electrical measuring instruments. Emphasis is laid on the meters used to measure current, voltage, resistance measuring methods, inductance and capacitance.
- To have an adequate knowledge in the measurement techniques for power and energy.
- Elaborate discussion about potentiometer and to impart knowledge on various instrument transformers and to understand the calibration of various meters.
- In-depth understanding and idea of analog and digital instruments.
- 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, Megger. 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 (Synchroscope),–Calibration of wattmeter and Energy meters- smart energy meters

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, Logic analyzer, spectrum analyzer – 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 & time period measurement, digital LCR meter

UNIT V DISPLAY AND RECORDING DEVICES 9

Cathode ray oscilloscope: Classification, Sampling and storage scopes –MSO, Seven segment, Organic Light Emitting Diode display, LCD– X-Y recorders —Digital Data Recording –Digital memory waveform recorder – Data loggers, IOT enabled recorder.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. 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. Ability to compare different bridge networks and to design bridge balances for finding out values of resistance, capacitance and inductance.
3. An ability to apply concepts of electronic instrumentation for measurement of electrical quantities.
4. Ability 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. E.W. Golding & F.C. Widdis, "Electrical Measurements and Measuring Instruments", Reem Publications Pvt, Ltd, 3rd Edition, 2011.
2. Albert D Helfrick, William D cooper, "Modern Electronic Instrumentation & Measurement Techniques", Pearson India Education, 2015.
3. David.A.Bell, Electronic Instrumentation and Measurements, Oxford University Press, 3rd Edition, 2013.

REFERENCE BOOKS:

1. Northrop, R.B., "Introduction to Instrumentation and Measurements", Taylor & Francis, New Delhi, 3rd Edition, 2017.
2. Carr, J.J., "Elements of Electronic Instrumentation and Measurement", Pearson India Education, New Delhi, 2011.
3. Sawhney, A.K., "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co, New Delhi, 2015.
4. Kalsi, H.S.," Electronic Instrumentation", Tata McGraw-Hill, New Delhi, 3rd Edition, 2017.

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	PSO 1	PSO 2	PSO 3
CO212.1	2	2	2	3		2	3	3	3	2	1	2	2		
CO212.2	3	2	3	3		3	2	1	2	3	1	3	3		
CO212.3	2	2	2	3		2	3	3	3	2	1	2	2		
CO212.4	3	2	3	3		3	2	1	2	3	1	3	3		
CO212.5	2	2	2	3		2	3	3	3	2	1	2	2		
CO212.6	3	2	3	3		3	2	1	2	3	1	3	3		
CO212	2.5	2	2.5	3		2.5	2.5	2	2.5	2.5	1	2.5	2.5		

EI5411	SENSORS AND SIGNAL CONDITIONING CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To make the students aware of basic concepts of measurement and operation of different types of transducers.
- To make the students conscious about static and dynamic characteristics of different types of transducer.
- To make the students study on the design of signal conditioning circuit for different transducers.

LIST OF EXPERIMENTS

1. Determination of Static and Dynamic characteristics of Thermocouple (J,K,E) with and without thermo-well.
2. Determination of Static and Dynamic characteristics of RTD and Thermistor.
3. Determination of Characteristics of linear displacement transducers (LVDT and Hall Effect sensor).
4. Determination of Characteristics of angular displacement transducers (Synchros and Capacitive transducer).
5. Determination of Characteristic study of load cell and pressure cell.
6. Sensitivity analysis of strain gauge bridges (quarter, half and full).
7. a. Determination of Static characteristic of flapper-nozzle system
   b. Loading effect on resistive potentiometer.
8. Determination of Characteristic of seismic type accelerometer.
9. Measurement of inductance (Anderson), capacitance (Schering) and resistance (Kelvin double) using bridges.
10. Design of signal conditioning circuits for resistive & capacitive sensors
11. Design of signal conditioning circuits for inductive sensors
12. Design of cold junction compensation for Thermocouples and lead wire compensation schemes for RTD.

TOTAL : 60 PERIODS

COURSE OUTCOMES

1. Ability to understand the concept of Data Acquisition in real-time environment using LabVIEW.
2. Ability to perform the measurement of error, uncertainty and sensitivity analysis.
3. Ability to evaluate the static and dynamic characteristics of measuring instruments.
4. Ability to design and construct measurement systems using resistive, inductive and capacitive sensors.
5. Acquire knowledge of importance in calibration for special transducers.
6. Ability to interface and analysis of different signal conditioning units.
7. Ability to design and experimentation on various measuring instruments.
8. 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	PSO 1	PSO 2	PSO 3
CO213.1	3	2		2	3			2					1	2	
CO213.2	3	3	3		2			2				1	1	2	
CO213.3	2	3	1	3	2			2				1	1	2	
CO213.4	3	2			2			2				1	2	2	3
CO213.5	3				2			2				1	1	2	
CO213.6	3	3	2					2					1	2	3
CO213.7	2		3	3				2		2			1	2	
CO213.8	2							2	3	2			1	2	
CO213	2.7	2.6	2.3	2.7	2.2			2	3	2		1	1.1	2	3

HM5501	PROJECT MANAGEMENT AND FINANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To outline the need for project management.
- To outline the importance of finance and accounting.
- To demonstrate knowledge and understanding of the engineering and management principles.
- 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. Ability to prepare project feasibility report, Project preparation Implementation.
2. Ability to understand the role and responsibility of the Professional Engineer.
3. Be able to assess social, health, safety issues based on the reasoning received from the contextual knowledge.
4. Apply the organizing principle to ensure a management's smooth operation.
5. Determine the effects of each leadership style by evaluation process.
6. Determine the best management strategies to use and implement them when managing a firm.

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.

REFERENCE BOOKS:

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	PSO 1	PSO 2	PSO 3
CO301.1	3					2		2	3	3	3	3	3		
CO301.2	3					2		2	3	3	3	3	2		

CO301.3	3		1			1		2	2	1	3	3	2		
CO301.4	3	3	2			2		2		1	3	3	2		
CO301.5	3	2	1			1		2		1	3	3	2		
CO301.6	3	3	3			3	2	2		2	2	2	2		
CO301	3	2.7	1.75			1.8	2	2	2.7	1.8	2.8	2.8	2.1		

EI5501	DISCRETE TIME SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To introduce the basic concepts of Digital Signal processing

- To make the students familiarize various mathematical tools for analyzing Discrete Time Systems.
- To make the students design Digital Filters based on the Filter specifications.
- To provide the exposure to the architectures of DSP processors.
- To implement various algorithms in DSP for solving Real-time problem.

UNIT I DFT AND FFT **9**

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

UNIT II DIGITAL IIR FILTERS **9**

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

UNIT III DIGITAL FIR FILTERS **9**

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

UNIT IV RANDOM PROCESS **9**

Introduction to Statistical signal processing – Random process and random variables – Autocorrelation, Cross correlation, Stationary / Wide-sense stationary / Ergodic random processes, Wiener-Khintchine theorem – Power Spectral Density.

UNIT V ADAPTIVE DIGITAL SIGNAL PROCESSING **9**

Signal modeling - AR, MA and ARMA processes – Yule Walker equations – Wiener Hopf equations, FIR Wiener Filter and its applications – Overview of Multirate signal processing:- Decimation, Interpolation, STFT and DWT

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

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

1. Ability to apply the mathematical tools such as DFT and FFT algorithms for discrete time signal processing
2. Ability to understand the various types of digital IIR/FIR filters and their design procedures
3. Ability to design digital IIR/FIR filters for a given set of specifications
4. Ability to characterize and classify random processes
5. Ability to model random processes and the fundamentals of multirate signal processing
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, 4th edition, 2004
2. Tarun Kumar Rawat, "Signals and Systems", Oxford University Press, 2010.
3. Johnson, J.R.," Introduction to Digital Signal Processing", Prentice Hall of India, 2009.

REFERENCE BOOKS:

1. Mitra, S.K., "Digital Signal Processing" – A Computer Based Approach', Tata McGraw Hill, 2001. 4th edition.
2. Uyemura, J.P., "A first course in Digital System Design An integrated approach", Cengage Learning, 2000. 1st edition, 2006.
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	PSO 1	PSO 2	PSO 3
CO302.1	3	2	1	2	1							1			
CO302.2	3	2	1	2	1	1						1	2		
CO302.3	3	2	2	3	3							1			
CO302.4	2	3		3	2		2					2	2	3	1
CO302.5	2	3	3	3	2		2					2		3	1
CO302.6	3	3	3	3	3	2						3	3	3	1
CO302	2.7	2.5	2	2.7	2	1.5	2					1.7	2.3	3	

EI5502	INDUSTRIAL INSTRUMENTATION - I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make the students understand the various measuring techniques for force, torque, speed, acceleration, vibration, density, level, temperature and pressure.
- To make the students understand the construction, working principle, application and selection of various transducers used for the measurement of force, torque and speed.
- To give the students knowledge about various methods of acceleration, vibration and density measurement practiced in industries.
- To provide knowledge on different level measurement techniques practiced in industries and able to select appropriate sensor.
- To provide knowledge on different temperature measurement techniques and its selection.
- To provide knowledge on different pressure transmitters and its selection.

UNIT I MEASUREMENT OF FORCE, TORQUE AND SPEED 9

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

UNIT II MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY 9

Accelerometers: LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers – Mechanical type vibration instruments – Seismic instruments as accelerometer – Vibration sensor – Calibration of vibration pickups – 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 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 transmitter and Hydra step methods – Solid level measurement.

UNIT IV TEMPERATURE MEASUREMENT **9**

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 - Smart Universal Temperature Transmitter.

UNIT V PRESSURE MEASUREMENT **9**

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

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to compare instruments used for measurement of force, torque, speed, acceleration, vibration, density, level, pressure and temperature.
2. Ability to select instruments according to the application.
3. Ability to calibrate measuring instruments.
4. Ability to design compensation techniques for measuring instruments.
5. Ability to design signal conditioning circuits for various transducers.
6. Ability to design and develop a field transmitter with special features.

TEXT BOOKS:

1. Doebellin, E.O. and Manik D.N., "Measurement systems Application and Design", 5th Edition, Tata McGraw Hill Education Pvt. Ltd, 2008.
2. Jones. B.E., "Jones"s Instrument Technology", Vol.2, Butterworth-Heinemann, 4thEdition, Elsevier, 2016.

REFERENCE BOOKS:

1. Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press, 4th Edition, 2012.
2. Patranabis, D., "Principles of Industrial Instrumentation", 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.
3. Eckman D.P., "Industrial Instrumentation", Wiley Eastern Limited, 2016.
4. Singh,S.K., "Industrial Instrumentation and Control", Tata Mc-Graw-Hill Education Pvt. Ltd., 3rd Edition, New Delhi, 2010.
5. AlokBarua, "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	PSO 1	PSO 2	PSO 3
CO303.1	3	1	1	1	1	2	1	1		1		1	3		
CO303.2	3	2	2	1	2	2	1	1		1	1	1	3		
CO303.3	3			1	1	2	2	2	1	1	1	1	3		
CO303.4	3	1	1	1	2	1		1		1	1		3		

CO303.5	3	2	2	2	2	1	1	1		1	1	1	3		
CO303.6	3	3	3	3	3	2	1	1		1	2	2	3		
CO303	3	1.8	1.8	1.5	1.9	1.6	1.2	1.2	1	1	1.2	1.2	3		

EI5503	**CONTROL SYSTEM ANALYSIS AND DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To make the students familiarize various representations of systems.
- To introduce the formulation of linear models like state variable model and Transfer function model.
- To make the students analyze the stability of linear systems in time domain and frequency domain.
- To make the students design compensator based on the time and frequency domain specifications.

UNIT I MODELING OF LINEAR TIME INVARIANT SYSTEM (LTIV) 9

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 9

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- State Observer - State Feedback Control

UNIT III TIME DOMAIN AND STABILITY ANALYSIS 9

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 9

Bode plot, Polar plot and Nyquist plot: Construction, Interpretation and stability analysis – Frequency domain specifications - Introduction to closed loop Frequency Response.

UNIT V DESIGN OF FEED BACK CONTROL SYSTEM 9

Design specifications – Lead, Lag and Lag-lead compensators using Root locus and Bode plot technique.

TOTAL :45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the technical terms associated with control system.
2. Acquire the skill to develop various representations of system based on the first principles approach.
3. Ability to determine time and frequency responses and infer the time domain and frequency domain specifications from the response.
4. Ability to construct and interpret root locus, Bode plot, polar plot and Nyquist plot.
5. Ability to analyze higher order systems using appropriate software tools.
6. Ability to come out with the solution to analyze and infer the stability of systems in time and frequency domain.
7. Ability to design and implement lag, lead, lag-lead compensators to meet the time and frequency domain specifications.

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TEXT BOOKS:

1. Benjamin C. Ku and Farid Golnaraghi, "Automatic Control Systems",10th edition McGraw-Hill Education, 2017.
2. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", 6th edition New Age International Publishers 2017.
3. Graham C.Goodwin, Stefan F.Graebe, Mario E.Salgado, "Control system design",2002.

REFERENCE BOOKS:

1. Richard C.Dorf and Robert H.Bishop,., "Modern Control Systems", Education Pearson, 13th Impression 2017.
2. John J.D., Azzo Constantine, H. and Houpis Sttuart, N Sheldon, "Linear Control System Analysis and Design with MATLAB", CRC Taylor& Francis Reprint 2014.
3. Katsuhiko Ogata, "ModernControl Engineering",PHI Learning Private Ltd, PEARSON, 5th Edition,2015.
4. NPTEL Video Lecture Notes on "Control Engineering "by Prof.S.D.Agashe, IIT Bombay.

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	PSO 1	PSO 2	PSO 3
CO304.1	3	1			1			1		1			2	3	3
CO304.2	3	2	2	2	2			1		1			2	3	3
CO304.3	3	2	2	2	2			1		1			2	3	3
CO304.4	3	2	2	2	2			1		1			2	3	3
CO304.5	3	3	3	3	3			1		1			2	3	3
CO304.6	3	3	3	3	3			1		1			2	3	3
CO304.7	3	3	3	3	3			1		1			2	3	3
CO304	3	2.3	2.5	2.5	2.3			1		1			2	3	3

EI5511	EMBEDDED SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	6	3

LIST OF EXPERIMENTS

Practical Module–1 Introduction to Embedded Hardware	
Objective(s)	To introduce embedded system and its fundamental building blocks To make the students familiar with the architectural features and instruction set of microcontrollers/microprocessors
Demonstration	Overview of on-board peripherals of the embedded trainer kit
Experiment(s)	Implementing specific tasks on microcontrollers/microprocessors through assembly language. Constructing simple control applications on microcontrollers/microprocessors through assembly language .
Assignment(s)	Sorting an array and code conversion. Development of mathematical operations.
Practical Module–2 Introduction to Embedded C programming	

Objective(s)	To introduce Embedded C programming and its fundamental building blocks To make the students effectively utilize the versatile features of Embedded C programming for embedded applications
Demonstration	Building the source code for the required application on an Integrated Development Environment and loading the same onto the chosen microcontroller through In System Programming.
Experiment(s)	Implementing conditional and loop control operations using Embedded C. Implementing specific tasks using functions.
Assignment(s)	Building a simple calculator . Development of simple applications using recursion.
Practical Module–3 Interfacing of input devices (Switches and keypad)	
Objective(s)	To introduce Programmable Peripheral Iinterface and built-in I/O Ports of microcontrollers
	To provide an insight over interfacing different kinds of input devices such as switches and keypad with microcontrollers/microprocessors
Demonstration	Interfacing 8255 with microprocessor
Experiment(s)	Interfacing Push buttons with microcontroller. Interfacing Limit switches with microcontroller.
Assignment(s)	Design of simple calculator using 4x4 keypad and display it using LCD module. Simple control applications using level limit switches.
Practical Module–4 Interfacing of output devices (Actuators and Display Devices)	
Objective(s)	To interface various output devices such as actuators and display devices and their applications To sensitize the students about voltage level converters needed for voltage compatibility
Demonstration	Interfacing LED with microcontroller
Experiment(s)	LCD/Seven segment display interface. Switching ON/OFF the pump using microcontroller.
Assignment(s)	Simple DC/Stepper motor direction control using suitable driver module Interfacing heating element and solenoid valve with microcontroller using electromechanical relays
Practical Module–5 Timers / Counters	
Objective(s)	To make the students understand the concept of on-chip Timers / Counters andprogrammable interval timer To enable the students to configure the Timer / Counter and familiarize with the scaling concepts
Demonstration	Interfacing 8253 with microprocessor
Experiment(s)	Making LEDs ON/OFF for predefined time using Timer (with and withoutscaling). Counting the occurrence of events using IR proximity sensor.
Assignment(s)	Design of a Programmable Timer . Frequency measurement using Timer / Counter.

Practical Module–6 Interrupts	
Objective(s)	To make the students understand the concept of interrupts and their classifications. To facilitate the students to realize the potential of interrupts in the given embedded architecture
Demonstration	Interfacing 8259 with microprocessor
Experiment(s)	Interfacing switch using hardware interrupt. Acknowledging the transmission and reception of information using interrupt.
Assignment(s)	Design of real-time clock using software interrupt. Generation of interrupt using timer to activate/deactivate field devices.

Practical Module-7 ADC/DAC	
Objective	To make the students understand the operational features of various types of ADCs / DACs. To provide an insight over data acquisition to carry out signal processing.
Demonstration	Interfacing ADC/DAC with microcontroller using Proteus Design Suite. Acquisition of a continuous signal and reconstruction of its sampled version.
Experiment	Interfacing analog transmitter with microcontroller. Interfacing final control element with microcontroller.
Assignment	Design of a multichannel data acquisition system. Design of a smart transmitter.
Practical Module–8 Memory Interfacing	
Objective	To effectively utilize the available built-in memory in a given architecture and realize the need for external memory storage To interface external data and program memories
Demonstration	Illustrating different operating modes of microcontroller through various memory configurations
Experiment	Storing a block of data in external RAM and fetching the same.Interfacing external flash memory with microcontroller.
Assignment	Switching program execution between internal and external memories.Reprogramming the specified block of flash memory.
Practical Module–9 Communication Modules	
Objective	To make the students familiar with synchronous(I^2C&SPI) and asynchronous(UART) communication protocols To impart knowledge on establishing communication between microcontrollers and peripherals using appropriate serial communication protocols
Demonstration	Remote data transmission using both synchronous and asynchronous communication protocols.
Experiment	I^2C based DAC interface and SPI based ADC interface. Remote transmission of field transmitter data to PC.
Assignment	Interfacing RTC with microcontroller using I^2C interface. Interfacing EEPROM with microcontroller using SPI interface.
Practical Module–10 Wireless Communication Modules	
Objective	To introduce various wireless communication protocols To facilitate the students to acquire field parameters through wireless communication Protocols

Demonstration	Establishing communication between microcontroller and PC using Zigbee module.
Experiment	Remote transmission of sensor data using Zigbee protocol.
Assignment	Remote monitoring of process using Zigbee protocol.
Practical Module	**–11 RTOS Concepts**
Objective	To facilitate the students to realize the power of RTOS and its operational characteristics To enable the students to perform task scheduling and establish inter-task communication
Demonstration	Implementing multitasks on an RTOS enabled embedded system
Experiment	Design of a multichannel data acquisition system with time, interrupt, task and memory management features.
Assignment	Implementation of a real-time control application (Inverted pendulum or dcmotor etc.) using RTOS.
Practical Module	**–12 IoT Enabled Embedded Systems**
Objective	To impart knowledge on the inherent features of IoT for embedded applications To enable the students to carry out IoT enabled data acquisition
Demonstration	Building an IoT application using Python
Experiment	IoT enabled field sensing.
Assignment	Development of IoT enabled transmitter.
Mini Project	
	P/C based PID Control Strategy for Temperature/Level Process.

TOTAL : 90 PERIODS

COURSE OUTCOMES

1. Ability to infer the concept of embedded system and its architectural features
2. Ability to familiarize with the basic concept of Embedded C programming and its significant features
3. Ability to integrate/interface the real world input devices with microcontrollers/microprocessors
4. Ability to integrate/interface the real world displays and actuators with microcontrollers using relays
5. Ability to configure and utilize the services of timer for a given application
6. Ability to understand the Interrupt structure of an architecture and utilize it for interfacing switches and serial I/Os.
7. Ability to acquisition of real world signals using suitable data converters for control applications
8. Ability to identify the need for external memory and explore memory interfacing.
9. Ability to interface peripherals using respective communication protocols
10. Ability to compare and justify the use of specific wireless communication protocol for process automation
11. Ability to utilize RTOS for an real time embedded system design
12. Explore remote data acquisition using IoT
13. Ability to apply the acquired technical skills in embedded programming and use it to develop microcontroller based closed loop control system for a typical process.

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	PSO 1	PSO 2	PSO 3
CO305.1	3	3	3	3	3	3	1	1	3	2	1	3	2	2	
CO305.2	3	3	3	3	3	3	1	1	3	2	1	3	1	2	
CO305.3	3	3	3	3	3	3	1	1	3	2	1	3	2	2	

CO305.4	3	3	3	3	3	3	1	1	3	2	1	3	2	2	
CO305.5	3	3	3	3	3	3	1	1	3	2	1	3	2	2	
CO305.6	3	3	3	3	3	3	1	1	3	2	1	3	2	2	
CO305.7	3	3	3	3	3	3	1	1	3	2	1	3	1	2	
CO305.8	3	3	3	2	3	3	1	1	3	2	1	3	2	2	
CO305.9	3	3	3	2	3	3	1	1	3	2	1	3	2	2	
CO305.10	3	3	3	3	3	3	1	1	3	2	1	3	1	2	
CO305.11	3	3	3	3	3	3	1	1	3	2	1	3	1	2	
CO305.12	3	3	3	3	3	3	1	1	3	2	1	3	2	2	
CO305.13	3	3	3	3	3	3	1	1	3	2	1	3	1	2	
CO305	3	3	3	2.85	3	3	1	1	3	2	1	3	1.6	2	

EI5512	**CONTROL AND INSTRUMENTATION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES

- To make the students understand the concepts of control.
- To make them use modern tools to simulate and understand the dynamic behavior of physical systems.
- To make them familiar with conducting experiments on real time set up.
- To make the students understand the working and operation of different types of measuring instruments.
- To make the students understand the compensation techniques
- To make students gain knowledge on calibration and uncertainty estimation of measuring instruments.
- To provide practical knowledge in interfacing transmitters with PC.

LIST OF EXPERIMENTS

CONTROL:

1. Determination of time and frequency responses of a LTI system. (Mechanical, Electrical,Electro mehanical and Hydraulic system)
2. Design, Analysis and implementation of lag and lead compensators using Bode and Root locus for a physical system.
3. Design, Analysis and implementation of lag-lead compensator using Bode and Root locus for a physical system.
4. Design and implementation of feedback control scheme for an open loop stable system.
5. Design and implementation of controller for an open loop unstable system.
6. Design and implementation of state feedback control scheme for a MIMO system.

INSTRUMENTATION:

1. Configuration and Calibration of temperature transmitter using temperature calibrator.
2. i. Measurement of temperature using IR thermometer.
   ii.Calibration of IR thermometer.
   iii.Study of thermal image camera.
3. Measurement of torque, speed and density.
4. Calibration of ammeter, voltmeter and wattmeter using multi-function calibrator.
5. i. Testing of pressure gauge using dead-weight tester
   ii. Configuration and calibration of Pressure Transmitter
6. i. Level measurement using differential pressure transmitter including elevation considerations
   ii. PC interface with level transmitter

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.
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	PSO 1	PSO 2	PSO 3
CO306.1	3	3			3			1	3	1			3	2	
CO306.2	3	3	3		3			1	3	1			3	2	
CO306.3	3	3	3		3			1	3	1			3	2	
CO306.4	3	3						1	3	1			3	2	
CO306.5	3	3						1	3	1			3	2	
CO306.6	3	3						1	3	1		2	3	2	
CO306.7	3							1	3	1		2	3	2	
CO306.8	3							1	3	3		2	3	2	
CO306	3	3	3		3			1	3	1.25		2	3	2	

EI5601	POWER ELECTRONICS DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS 9

Operating principle and switching Characteristics : Power diodes - Power BJT, Power MOSFET, IGBT, SCR, GTO,MCT, Power integrated circuits (PIC) – Drive and Protection circuits – Series and parallel operations– 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 Cyclo converters, 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, Fourth edition, 2014.
2. Mohan, Udeland and Robbins., "Power Electronics", John Wiley and Sons, New York, 3rd edition 2006.

REFERENCE BOOKS:

1. Singh, M.D., and Khanchandani, K.B., "Power Electronics", 2nd Ed., Tata McGraw-Hill, 2017.
2. Bose, B.K., "Modern Power Electronics and AC Drives", Pearson Education, 2002.
3. Bimbra, P.S., "Power Electronics", Khanna Publishers, 5th edition, 2012.
4. Moorthi, V.R., "Power Electronics - Devices, Circuits and Industrial Applications", Oxford University Press, 2005.
5. NPTEL Lecture Series on "Power Electronics" by Dr.B.G.Fernandes, IIT Bombay.

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	PSO 1	PSO 2	PSO 3
CO307.1	1	2	1	1	2						1	1		1	
CO307.2	2	2	3	1	2						1	2		1	1
CO307.3	1	2	3	1	2						1	2		1	1
CO307.4	3	2	3	2	2						1	2		1	2
CO307.5	1	1	1	1	3						1	2		1	2
CO307	1.6	1.8	2.2	1.2	2.2						1	1.8		1	1.5

EI5602	INDUSTRIAL INSTRUMENTATION - II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make the students acquainted with knowledge on variable head flow measurement techniques and its application considerations.
- To provide knowledge on different area and mass flow meters and its selection.

- To educate students in selection and calibration of various transducers used for measuring flow, viscosity, humidity and moisture.
- To enable the students get acquainted with various electrical type flow meters.
- To make students understand the construction, working principle for various measuring techniques of flow, viscosity, humidity and moisture.
- To provide knowledge on different safety zone followed in industries.

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 - Smart Flow Transmitter.

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 - Four Wire Transmitter.

UNIT IV MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE 9

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

UNIT V SAFETY ZONE CLASSIFICATION 9

Hazardous area classification - Electrical and other physical hazards – Chemical reaction hazards – Explosion hazards – Flammability classification – Hazard control: Reliability and risk analysis – Active protective systems and instrumentation – Overpressure relief – Instrumentation for control and safety - Intrinsic Safe Transmitter.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to understand the working principle of measuring instruments for flow, viscosity, humidity and moisture.
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.
7. Capable to identify the appropriate use of instruments in process industries according to the safety practices.

TEXT BOOKS:

1. Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press, 4th Edition, 2012.
2. Doebellin, E.O. and Manik D.N., "Measurement systems Application and Design", 5th Edition, Tata McGraw Hill Education Pvt. Ltd, 2008.
3. Patranabis, D., "Principles of Industrial Instrumentation", 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2017.

4. King, R Safety in the process industries. Elsevier,2016.

REFERENCE BOOKS:

1. Jain, R.K., "Mechanical and Industrial Measurements: Process Instrumentation and Control", Khanna Publishers, Delhi, 2008.
2. Singh, S.K., "Industrial Instrumentation and Control", Tata McGraw Hill Education Pvt. Ltd., 3rdEdition, New Delhi, 2010.
3. Jayashankar, V., "Lecture Notes on Industrial Instrumentation", NPTEL, E-Learning Course, IIT Madras.
4. Bahadori, A. Hazardous area classification in petroleum and chemical plants: a guide to mitigating risk, CRC Press,2013.

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	PSO 1	PSO 2	PSO 3
CO308.1	**1**	**1**	**2**	**2**		**1**	**1**					**1**	**2**		
CO308.2	**2**	**3**	**2**	**3**		**1**	**2**	**1**				**1**	**3**		
CO308.3	**3**	**3**	**2**	**3**		**1**	**2**					**1**	**3**		
CO308.4	**2**	**1**	**2**	**1**		**1**	**1**					**1**	**3**		
CO308.5	**1**	**1**	**1**	**1**		**1**	**1**					**1**	**3**		
CO308.6	**3**	**2**	**2**	**3**		**1**	**2**	**1**				**1**	**3**		
CO308.7	**3**	**2**	**3**	**2**		**1**	**3**	**3**				**1**	**3**		
CO308	2.1	1.9	2	2.1		1	1.7	1.7				1	2.9		

EI5603	PROCESS CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I PROCESS DYNAMICS **9**

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.

UNIT II CONTROL VALVE **9**

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– Control Valve selection.

UNIT III CONTROL ACTIONS **9**

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.

UNIT IV PID CONTROLLER TUNING – SINGLE LOOP REGULATORY CONTROL & ENHANCEMENT TO SINGLE LOOP REGULATORY CONTROL **9**

PID Controller Design Specifications: Criteria based on Time Response and Frequency Response - PID Controller Tuning: Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, Auto tuning – Cascade control – Feed-forward control – Ratio control – Inferential control – Split-range– Adaptive Control.

UNIT V MODEL BASED CONTROL SCHEMES & INTRODUCTION TO MULTI-LOOP REGULATORY CONTROL & CASE –STUDIES **9**

Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller –Model Predictive Control- Introduction to Multi-loop Control Schemes – Control Schemes for Distillation Column, pH-Three-element Boiler drum level control.

TOTAL : 45 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.

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, 4th Edition,2017.
2. Bequette, "Process Control: Modeling, Design, and Simulation", Prentice Hall of India, 2004.
3. George Stephanopoulos, "Chemical Process Control – An Introduction to Theory and Practice", Prentice Hall of India, 2005.

REFERENCE BOOKS:

1. Michael King, "Process Control: A Practical Approach", Wiley, 2016.
2. Baumann, H.D., "Control Valve Primer – A User's Guide", ISA, 2009.
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. 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	PSO 1	PSO 2	PSO 3
CO309.1	3				2			1		1				3	2
CO309.2	3	3	3		2			1		1				3	2
CO309.3	3	2		3	2			1		1				3	2

CO309.4	3	2	3		3			1		1				3	2
CO309.5	3	3	3		3			1		1				3	2
CO309.6	3	3		3	2			1		1				3	2
CO309.7	3	2	3		3			1		1				3	2
CO309	3	2.5	3	3	2.4			1		1				3	2

EI5611	**PROCESS CONTROL AND INSTRUMENTATION LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES

To impart theoretical and practical skills in

- Process Identification
- Tuning of PID controller and PID Enhancements.
- Design and Implementation of Cascade, Feed-forward Control Schemes and advanced Control schemes using the facilities available in the Process Control lab.

PROCESS CONTROL:

1. i. Study of a Process Control Training plant.
   ii. Determination of characteristics of a Pneumatically Actuated Control valve (with and without Positioner).
2. i. Design and implementation of ON-OFF controller for the Temperature Process.
   ii. Design and Implementation of split range control for a level process.
3. i. Design and Implementation of Practical Forms of PID Controller on the simulated model of a Typical Industrial Process. ii. Design and Implementation of Feed forward and Cascade control schemes on the simulated model of a Typical Industrial Process
4. i. Analysis of MIMO system.
   ii. Design and implementation of Multi-loop PID schemes on the simulated model of a Typical Industrial Process.
   iii. Interpretation of P & ID (ISA S5.1)
5. i. Cascade Control of Level and flow process using industrial type PID controller.
   ii. PC based control of level process.
   iii. On-line monitoring and control of a pilot plant using an industrial type distributed control system.
6. Design and implementation of advanced control scheme (adaptive controller or model predictive Control scheme) on the skid mounted pilot plant.

INSTRUMENTATION

1. Estimation of discharge coefficient of an Orifice plate(With and without U bend in the pipeline)
2. i. Interfacing different types of flow meters with PC.
   ii. Configuration of flow Transmitter.
3. i. Measurement ofhumidity and viscosity
   ii. Design and testing of Electromagnetic flow meters.
4. Determining the stoichiometric ratio of air fuel mixture in the combustion chamber.
5. i. Measurement of Absorbance and Transmittance of Test solutions using UVVisible Spectrometer.
   ii. Measurement of Conductivity and pH of Test solutions

6 i. Monitoring Physiological Parameters using Vital signs monitor.
   ii. Assessment of electrical safety of devices using electrical safety analyzer.

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.

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	PSO 1	PSO 2	PSO 3
CO310.1	3	2	2	3	3	2	2	2	3	3	1		2	2	
CO310.2	3	3	3	3	3	1	1	3	3	3	2		2	2	
CO310.3	3	2	2	3	3	2	2	3	3	3	2		2	2	
CO310.4	3	3	3	3	3	1	1	3	3	3	2		2	2	
CO310.5	3	3	2	3	3	1	1	3	3	3	2		2	2	
CO310.6	3	1	2	3	2	2	2	3	3	3	2		2	2	
CO310.7	3	3	3	3	3	3	3	3	2	3	3	2	2	2	
CO310.8	3	2	2		1	2	3	3	2	3	3	3	2	2	
CO310.9	2				1	3	2	3	3	3	3	3	2	2	
CO310	2.8	2.4	2.4	3	2.4	1.8	1.8	2.9	2.8	3	2.2	2.7	2	2	

EI5612	**INDUSTRIAL AUTOMATION SYSTEMS LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**6**	**3**

COURSE OBJECTIVES

- To impart knowledge on architecture of PLC and DCS.
- To introduce students on how to program using all five IEC-61131-3 programming languages.
- To introduce students on how to interface Field devices (Conventional/Smart) with PLC and DCS.
- To make the students configure the IoT gateway

LIST OF EXPERIMENTS

Practical Module – 1: Study of PLC architecture and Field Device Interface Modules (AI, AO, DI, DO Modules).	
Objective(s)	Impart knowledge on PLC architecture including CPU, I/O module, connecting I/O modules (DI/DO/AI/AO modules) to CPU, Power supply module and Communication module & Hot swapping, Industrial certifications.
Demonstration	Configuration of a PLC.

Experiment(s)	1. Study of DI/DO/AI/AO modules of all PLCs. 2. Installation &Configuration of I/O modules 3. Understanding one of the PLC Control panels wiring diagram and creating a control panel layout
Assignment(s)	1. Comparison of all PLCs in the lab. 2. Market survey of the recent PLCs and comparison of their features with thePLCs available in the lab.
Practical Module – 2: Realization of discrete control sequence using Ladder Logic Programming	
Objective(s)	1. Introduce students to Programming PLC using (IEC 61131-3). Programming languages To make students familiarize and realize discrete control sequences using Ladder Logic Instruction set.
Demonstration	Procedure for filling and draining of liquid in a single tank setup using Ladder Logic instruction set.
Experiment(s)	1. Implementation of Alarm annunciator sequence (ISA 18.1 Standard)using ladder logic programming.
Assignment(s)	1. Exercises covering all instruction set. 2. Implementation of Traffic light control sequence using Ladder Logic programming. 3. Assignment on drawing shapes using Three axis control of Robotic Penusing Ladder Logic programming.
Practical Module – 3: Realization of Discrete control sequences using Functional Block Diagram(FBD) Programming	
Objective(s)	Introduce students to FBD programming and make them to realize Discrete control sequences using Function blocks
Demonstration	Demonstration of filling and draining of liquid in a single tank experimental setup using Function blocks.
Experiment(s)	1. Implementation of Alarm annunciator sequence (ISA 18.1 Standard) using FBD. Implementation of Reversal of direction of rotation of DC motor using FBD.
Assignment(s)	1. Exercises covering all function blocks. Implementation of Traffic light control sequence using FBD.
Practical Module – 4: Realization of Discrete control sequences using ST, IL and SFC Programming methods.	
Objective(s)	Introduce students to ST, IL and SFC Programming methods and make them to realize Discrete control sequences using ST,IL and SFC.
Demonstration	Demonstration of Traffic light control sequences using ST,IL and SFC programming methods.
Experiment(s)	Implementation of Alarm annunciator sequence (ISA 18.1 Standard) using ST,IL and SFC programming methods.
Assignment(s)	1. Exercises covering all instruction set of IL,ST and SFC. 2. Reversal of direction of rotation of DC motor using ST,IL and SFC programming methods.
Practical Module – 5 Interfacing Analog/Digital Input/output Devices with Industrial Type PLC.	
Objective(s)	To introduce students on how to Interface transmitters, limit switches, final control elements with PLC.
Demonstration	How to Interface field devices to a PLC – Case Study: How to interface field devices available in the filling and draining of liquid in a single

	tank experimental test setup to a PLC
Experiment(s)	1. Interfacing Level Transmitter and Control valve with PLC. 2. Interfacing Limit switches and a Pump with PLC.
Assignment(s)	1.Interfacing Temperature Transmitter and Heater with PLC. 2.Interfacing Flow Transmitter and Variable-speed pump with PLC.
Practical Module – 6 Closed loop control of a typical process using PLC.	
Objective(s)	To introduce students on how to configure PID control block to achieve closed loop control.
Demonstration	Configuration of PID Function Block
Experiment	On-line Monitoring and Control of Level Process using PLC
Assignment(s)	On-line Monitoring and Control of Processes such as Flow, Temperature and Pressure, using PLC.
Practical Module – 7 HMI/ SCADA Programming	
Objective(s)	SCADA/HMI development, configuration of face plates, creation of logs, Transmitter data trend displays, linking of tags with graphics
Demonstration	HMI/SCADA development for the Pressure Control Station.
Experiment(s)	HMI/SCADA development for the Process Control Training Plant(Level/Flow Process)
Assignment(s)	HMI/SCADA development for a Typical Industrial Processes
Practical Module-8 Architecture of DCS	
Objective(s)	Impart knowledge on DCS architecture including CPU, I/O module, connecting I/O modules (DI/DO/AI/AO modules) to CPU, Power supply module and Communication module & Hot swapping, Industrial certification
Demonstration	Configuration of DCS.
Experiment(s)	1. Study of AI, AO, DI, DO, H1-interface modules of all DCSs. 2. Installation &Configuration of I/O modules. 3. Understanding any one of the DCS Control panels wiring diagram and creating a control panel layout.
Assignment(s)	Market survey of the recent DCSs and comparison of their features with the DCSs available in the lab.
Practical Module-9 Interfacing of field devices with DCS.	
Objectives	To introduce students on how to Interface transmitters, limit switches, final control elements with DCS
Demonstration	1. How to Interface Level transmitter and Flow Transmitter in the ProcessControl Training Plant to a DCS. 2. How to interface Limit Switches, Pumps and Control valves in the Process Control Training Plant to a DCS.
Experiment(s)	1. Interfacing Temperature Transmitter and Variable Speed Pump to a DCS 2. Configuration of face plates, creation of logs and trend displays
Assignment(s)	Interfacing Temperature Transmitter and Heater and Variable Speed Pump with Pump Controller to a DCS.
Practical Module-10. Realization of control schemes for typical processes using DCS	
Objective	To introduce students on how to configure PID control block to achieve closed loop control
Demonstration	Configuration of PID Function Block and PID Faceplate
Experiment	On-line Monitoring and Control of Level Process using Distributed Control System.
Assignment(s)	On-line Monitoring and Control of Process such as Flow, Temperature and Pressure, using Distributed Control System.

Practical Module-11 Interfacing smart field devices with DCS.	
Objective	To introduce students on how to Interface smart field devices (HART/Foundation Field bus) with DCS.
Demonstration	Demonstration of 'PID control' in field devices.
Experiment(s)	Design and Implementation of Feedback control scheme (FF-PID) for the level process using DCS.
Assignment(s)	Market survey: Industrial Data Networks
Practical Module-12 IoT based monitoring of Level/Flow process	
Objective(s)	Introduction to IoT based monitoring.
Demonstration	Configuration of IoT gateway.
Experiment(s)	1. Interfacing transmitters to DCS through IoT gateway. 2. Cloud based Monitoring of level/flow process.
Assignment(s)	Cloud based Monitoring of temperature process.

TOTAL : 90 PERIODS

COURSE OUTCOMES

1. Ability to understand all the important components such as PLC, SCADA, DCS, I/O modules and field devices of an industrial automation system.
2. Ability to develop PLC program in different languages for industrial applications.
3. Gain hands on experience in interfacing transmitters and final control elements with PLC and DCS.
4. Be able to Configure and develop Feedback Control Schemes using PLC and DCS.
5. Able to select and use most appropriate automation technologies for a given application.
6. Able to configure IoT gateway for any industrial process using DCS.
7. Able to interface smart filed devices(HART /FF enabled field devices)with DCS and gain knowledge on the recent developments in industrial data networks.
8. Able to Develop ladder Logic/Functional Block Program for the Real time processes.
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.

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	PSO 1	PSO 2	PSO 3
CO311.1	3	3	3	3	3	2	3	3	3	3	3	3	2	2	3
CO311.2	3	3	3	2	3	1	1	3	3	3	2	1	2	2	3
CO311.3	3	3	3	3	3	2	1	3	3	2	2	3	2	2	3
CO311.4	3	3	3	3	3	1	1	2	3	3	2		2	2	3
CO311.5	3	3	3	3	3	3	1	2	2	3	3	3	2	2	3
CO311.6	3	3	3	3	3	2	1	2	2	2	3		2	2	3
CO311.7	3	3	3	3	3	2	2	2	3	2	3	1	2	2	3
CO311.8	3	3	3	3	3	1	1	2	2	2	3	2	2	2	3
CO311.9	3	1	1	1	1	2	2	3	3	3	3	3	2	2	3
CO311	3	2.8	2.8	2.8	2.8	1.7	1.4	2.4	2.7	2.6	2.7	2.3	2	2	3

EI5701	INDUSTRIAL DATA COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I DATA NETWORK FUNDAMENTALS 9

ISO/OSI Reference model - TCP/IP Protocol Stack- EIA 232 interface standard – EIA 485 interface standard - Media access protocol: Command/response, CSMA/CD — IEEE 802.3 Ethernet standard Bridges –Routers – TCP/IP - Gateways – Standard ETHERNET Configuration

UNIT II MODBUS AND HART 9

Evolution of industrial data communication standards - MODBUS:- Protocol structure, Function codes - HART communication protocol, Communication modes, HART Networks, HART commands, HART applications & Troubleshooting

UNIT III PROFIBUS AND FF 9

Fieldbus: Fieldbus architecture, Basic requirements of Fieldbus standard, Fieldbus topology, Interoperability and Interchangeability. 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. Devicenet: Introduction – Physical layer – Data link layer and Application layer.
Industrial Ethernet: Introduction – 10Mbps Ethernet – 100Mbps Ethernet- Gigabit Ethernet

UNIT V WIRELESS COMMUNICATION 9

Wireless sensor networks: Hardware components – energy consumption of sensor nodes – Network architecture – sensor network scenario. Wireless MAC Standards– IEEE 802.11- IEEE 802.15.4 – Zigbee Wireless HART – Wireless Standard for Process Industry – ISA100 – Introduction to Industrial IOT.

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

After completing the course, the students will gain ability to

1. Ability to gain knowledge on various types of industrial data network standards and the associated protocols based on their specifications and applications
2. Ability to analyze the various characteristics of each layer of the protocol stack pertaining to different Industrial data network standards
3. Ability to compare the performance of the standards and infer the advantages and drawbacks of each for a given industrial application
4. Ability to select and use the most appropriate networking technologies and standards for a given application
5. Ability to apply the gained knowledge on networking to choose a protocol and identify procedures for fault-free operations in the data communications links
6. Ability to infer the requirements of an industry and select 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,1st edition, Elsevier, 2004.
2. Buchanan,W., “Computer Busses: Design and Application”, CRC Press, 2000.
3. Bela G.Liptak, “Instrument Engineers’ Handbook, Volume 3 : Process Software and Digital Networks”, 4th Edition, CRC Press, 2011.

REFERENCE BOOKS:

1 Bowden,R., "HART Application Guide", HART Communication Foundation, 1999.
2 Berge,J., "Field Buses for Process Control: Engineering, Operation, and Maintenance", ISA Press, 2004.
3 Lawrence (Larry) M. Thompson and Tim Shaw, "Industrial Data Communications", 5th Edition, ISA Press, 2015.
4 NPTEL Lecture notes on," Computer Networks" 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	PSO 1	PSO 2	PSO 3
CO401.1	3	3	2	2	2	1		2	1	1	1	3	1		2
CO401.2	3	3	3	3	2	1		2	1	2	1	3	1		2
CO401.3	3	3	2	2	3	1		2	1	2	1	3	1		2
CO401.4	3	3	3	3	3	1		2	1	2	1	3	1		2
CO401.5	3	3	3	3	3	1		2	1	2	1	3	1		2
CO401.6	3	3	3	3	3	1		2	1	2	1	3	1		2
CO401	3	3	2.6	2.6	2.6	1		2	1	1.8	1	3	1		2

EI5702	INTRODUCTION TO PROCESS DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To introduce students the basic concepts of

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

UNIT I INTRODUCTION 9

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

UNIT II REGRESSION 9

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

UNIT III LINEAR MODEL SELECTION & REGULARIZATION 9

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

UNIT IV SUPERVISED LEARNING WITH REGRESSION AND CLASSIFICATION TECHNIQUES 9

Logistic regression– Linear Discriminant Analysis - Quadratic Discriminant Analysis – Regression & Classification Trees – Support Vector Machines - Random forests, Bagging and boosting - Neural Networks – Deep Learning

UNIT V APPLICATIONS **9**

Process data analysis for system identification (under open and closed loops) - Controller Performance Monitoring - Principal components analysis (PCA) for Process Monitoring and Partial Least Squares (PLS) for soft-sensor design - Data-based causality analysis for identification of process topology.

TOTAL: 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the statistical terms related to data analytics.
2. Ability to select the right regression method for a given application.
3. Ability to analyze and compare the performance of various model selection and regularization methods.
4. Ability to suggest and develop right classifier for a given application.
5. Ability to recommend appropriate data analysis tool for soft sensor development and controller performance monitoring.
6. Ability to use appropriate software tools for data driven analysis.

TEXT BOOKS:

1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer Texts in Statistics,2013.
2. Ethem Alpaydin, Introduction to Machine Learning, MIT Press,2013
3. Thomas A. Runkler, Data Analytics: Models and Algorithms for Intelligent Data Analysis, Springer Vieweg, 2nd Edition,2016.

REFERENCE BOOKS:

1. Arun K. Tangirala, Principles of System Identification – Theory and Practice, CRC Press,2015.
2. Huang, B. and Shah, S.L., Performance Assessment of Control Loops: Theory and Applications, Springer-Verlag,1999.
3. Fan Yang, Ping Duan, Sirish L Shah,TongwenChen,Capturing Connectivity and Causality in Complex Industrial Processes, Springer,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	PSO 1	PSO 2	PSO 3
CO402.1	3							1		1				1	1
CO402.2	3	3	2	2				1		1				1	1
CO402.3	3	3	3	3	3			1		1				1	1
CO402.4	3	3	3	2				1		1				1	1
CO402.5	3	3	2	3	3			1		1		3	3	3	3
CO402.6	3	3	2	2	3			1		1		3		1	1
CO402	3	3	2	2	3			1		1		3	3	1.3	1.3

EI5703	INTRODUCTION TO INDUSTRIAL PROCESSES, MEASUREMENT AND CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce common unit operations carried out in process industries.
- To impact knowledge about the important unit operations taking place in process industries.
- To prepare them to take up a case study on selected process industries like petrochemical industry, power plant industry and paper & pulp industry to make the students understand the different measurement and control techniques for important processes.
- Facilitate the students to apply knowledge to select appropriate measurement technique and control strategy for a given process.

UNIT I COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -I 9

Unit Operation, Measurement and Control :- Transport of solid, liquid and gases – Evaporators Crystallizers-Dryers.

UNIT II COMMON UNIT OPERATIONS IN PROCESS INDUSTRIES -II 9

Unit Operation, Measurement and Control :- Distillation – Refrigeration processes – Chemical reactors.

UNIT III PROCESS MEASUREMENT AND CONTROL INPETROCHEMICAL INDUSTRY 9

Process flow diagram of Petro Chemical Industry - Gas oil separation in production platform – wet gas processing – Fractionization Column – Catalytic Cracking unit – Catalytic reforming unit.

UNIT IV PROCESS MEASUREMENT AND CONTROL IN THERMAL POWER PLANT INDUSTRY 9

Process flow diagram of Coal fired thermal Power Plant– Coal pulverizer - Deaerator – Boiler drum - Superheater – Turbines.

UNIT V PROCESS MEASUREMENT AND CONTROL IN PAPER &PULP INDUSTRY 9

Process flow diagram of paper and pulp industry – Batch digestor – Continous sulphate digestor – Control problems on the paper machine.

TOTAL : 45 PERIODS

OUTCOMES

1. Ability to understand common unit operations in process industries
2. Ability to understand the dynamics of important unit operations in petro chemical industry
3. Ability to develop understanding of important processes taking place selected case studies namely petrochemical industry, power plant industry and paper & pulp industry
4. Ability to select appropriate measurement techniques for selective processes.
5. Ability to select controller structure based on the process knowledge.
6. Ability to understand the operation and challenges in integrated industrial processes.

TEXT BOOKS:

1 Balchan.J.G., and Mumme K.I., “Process Control Structures and Applications”, Van Nostrand Reinhold Company, New York, 1988.

2 Austin G.T and Shreeves, A.G.T., “Chemical Process Industries”, McGraw–Hill International student, Singapore, 1985.

REFERENCES:

1. Waddams, A.L., “Chemical from Petroleum”, Butter and JannerLtd.,1968.
2. Liptak B.G., “Instrument and Automation Engineers' Handbook: Process Measurement and Analysis”, Fifth Edition, CRC Press, 2016.

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	PSO 1	PSO 2	PSO 3
CO403.1	3	3	1					1		1					
CO403.2	3	3	1					1		1	2				2
CO403.3	3	3	1					1		1					
CO403.4	3	3	1	3	3			1		1			3	3	
CO403.5	3	3	3			3		1		1			3	3	3
CO403.6	3	3	2	3	2	1	2	1		2	1	1			2
CO403	3	3	1.5	3	2.5	2	2	1		1.16	1.5	1	3	3	2.3

EI5711	INSTRUMENTATION SYSTEM DESIGN LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

1. Design and Testing of 2-wire Analog Conventional Transmitter.
2. Design and Testing of 2-wire Smart Transmitter.
3. Design and Testing of Data Logger.
4. i). Design and Realization of Digital Filter.
   ii). Design, Fabrication and Testing of Analog PID Controller.
5. Design, Fabrication and Testing of Digital PID Controller.
6. Design, Fabrication and Testing of Alarm, Annunciation Circuits.
7. Design of Programmable Logic Controller using Microcontroller.
8. Development of Software Program for sizing Orifice.
9. Development of Software Program for sizing Control Valve.
10. Design and Implementation of IoT Enabled Transmitter
11. (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. Competence to design and fabricate conventional, smart and IoT enabled transmitters forkey process variables such as flow, level, pressure and temperature.
2. Potential to realize On/Off controller, PID controller and PLC.
3. Ability to design data loggers and alarm circuits for an industrial applicationrequirement.
4. Able to develop software programs for sizing control valve and orifice.
5. Capable of preparing documentation for Instrumentation projects.
6. Ability to exposure to simulation tools such as MATLAB/Proteus.
7. Ability to deliver the results in oral form as well as in written form as a report and graph.

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	PSO 1	PSO 2	PSO 3
CO404.1	3	3	3	2	3	1	1		2	2		1	2	2	
CO404.2	3	3	3	2	3	1	2		2	2		1	2	2	
CO404.3	3	3	3	2	3	1	2		2	2		1	2	2	
CO404.4	3	3	3	2	3	1	1		2	2		1	2	2	
CO404.5	3	3	3	2		1	1	3	3	3		1	2	2	
CO404.6	2	2	2	2	3		2		2	2		1	2	2	
CO404.7	2	2	2	2		1	3	3	3	3		1	2	2	
CO404	3	3	3	2	2.4	1	1.8	3	1.6	1.6		1	2	2	

EI5712	SUMMER INTERNSHIP SUMMER PROJECT (MINIMUM 4 WEEKS)	LT P C 0 0 0 2

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 ina novel way.
2. Learn methodology to select a good project and able to work in a team leading to development of hardware/software product.
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.

SUMMER INTERNSHIP SUMMER PROJECT (MINIMUM 4 WEEKS)

The student should undergo Internship for a minimum period of 4 weeks/ maximum 6 weeks in industry/ Research organization / academic institution. The student earns 2 credits by undergoing the Internship. Internship needs to be undergone continuously in one organization only. The student is allowed to undergo a maximum of 6 weeks Internship at the end of sixth semester during the summer vacation.

The Internship shall carry 100 marks. The review committee may be constituted by the Head of the Department. At the end of 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.

COURSE OUTCOMES(COs)

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

1. Select a good project and able to work in a team leading to development of hardware/software product.
2. Prepare a good technical report and able to present the ideas with clarity.
3. Gain Knowledge on various terminologies related to industrial environment.
4. Able to work efficiently as a member of different teams related to multidisciplinary projects.
5. 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
CO706.1	3	2	3	2	1	1	1	3	1	3	3	-	3	3	3
CO706.2	2	3	2	3	1	1	1	3	1	3	3	1	3	3	3
CO706.3	-	-	1	1	-	-	-	3	-	3	3	3	3	3	3
CO706.4	-		-		-	2	-	3	-	3	3	2	3	3	3

CO706.5	-	-	-	-	-	-	-	3	-	3	3	-	3	3	3
CO706	2.5	2.5	2	2	1	2	1.5	3	1.5	3	3	2	3	3	3

EI5713 **PROJECT I** **L T P C**
0 0 6 3

COURSE OBJECTIVES

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 ina novel way.
2. Learn methodology to select a good project and able to work in a team leading to development of hardware/software product.
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.

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 : 90 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
CO707.1	3	-	-	-	3	-	-	3	-	-	3	3	3	3	3
CO707.2	3	3	3	3	3	-	-	3	-	-	3	3	3	3	3
CO707.3	3	3	3	-	3	-	-	3	-	-	3	3	3	3	3
CO707.4	-	-	-	-	3	3	3	3	-	-	3	3	3	3	3
CO707.5	-	-	-	-	3	-	-	3	3	-	3	3	3	3	3

CO707.6	-	-	-	-	3	-	-	3	3	-	3	3	3	3	3
CO707.7	-	-	-	-	3	-	-	3	-	3	3	3	3	3	3
CO707.8	-	-	-	-	3	-	-	3	-	3	-	3	-	-	-
CO707	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

EI5811 **PROJECT II** **L T P C**
0 0 16 16

COURSE OBJECTIVES

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 ina novel way.
2. Learn methodology to select a good project and able to work in a team leading to development of hardware/software product.
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.

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 : 240 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**
CO801.1	3	-	-	-	3	-	-	3	-	-	3	3	3	3	3

CO801.2	3	3	3	3	3	-	-	3	-	-	3	3	3	3	3
CO801.3	3	3	3	-	3	-	-	3	-	-	3	3	3	3	3
CO801.4	-	-	-	-	3	3	3	3	-	-	3	3	3	3	3
CO801.5	-	-	-	-	3	-	-	3	3	-	3	3	3	3	3
CO801.6	-	-	-	-	3	-	-	3	3	-	3	3	3	3	3
CO801.7	-	-	-	-	3	-	-	3	-	3	3	3	3	3	3
CO801.8	-	-	-	-	3	-	-	3	-	3	-	3	-	-	-
CO801	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

EI5001	ANALYTICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the theory and operational principles of instrumental methods for identification and quantitative analysis of chemical substances by different types of spectroscopy.
- To impart fundamental knowledge on gas chromatography and liquid chromatography.
- To integrate a fundamental understanding of the underlining principles of physics as they relate to specific instrumentation used for gas analyzers and pollution monitoring instruments.
- To impart knowledge on the important measurement in many chemical processes and laboratories handling liquids or solutions.
- To understand the working principle, types and applications of NMR and Mass spectroscopy

UNIT I SPECTROPHOTOMETRY **9**

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

UNIT II CHROMATOGRAPHY **9**

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

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

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

Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

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

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

UNIT V NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY **9**

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

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the basic concept of qualitative and quantitative analysis of a given sample.
2. Ability to posess working knowledge of analytical instrumentation typically employed in chemical/biochemical research and industry laboratories
3. Ability to apply the fundamental principles of selective analytical instruments for separation, identification and quantitative analysis of chemical substances.
4. Describe and differentiate between online and offline process and identify suitable instruments for analysis.
5. Ability to appreciate the relative strengths and limitations of different instrumental based analysis methods.
6. Ability to assess and suggest a suitable analytical method for a specific application.

TEXT BOOKS:

1. Braun, R.D., "Introduction to Instrumental Analysis", Pharma Book Syndicate, Singapore, 2nd edition 2012..

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.

REFERENCE BOOKS:

1. Khandpur, R.S., "Handbook of Analytical Instruments", Tata McGraw Hill publishing Co. Ltd., 5th edition 2018.
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, 2016.
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	PSO 1	PSO 2	PSO 3
CO001.1	3	1	1	1	3	1	1	1	1	1	1	1	1	1	1
CO001.2	1	3	1	2	3	1	1	1	1	1	1	1	1	1	1
CO001.3	1	1	1	1	3	2	1	1	1	1	1	1	1	1	1
CO001.4	1	1	1	1	3	3	1	1	1	1	1	1	1	1	1
CO001.5	3	3	2	1	1	1	1	1	1	1	1	1	1	1	1
CO001.6	3	2	2	1	2	3	2	2	2	2	1	1	1	1	
CO001	2	1.8	1.2	1.2	2.6	1.6	1	1	1	1	1	1	1	1	1

EI5002	BIOMEDICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide an overview about various physiological signal measurements.
- To provide an overview about electrical parameter acquisition and recording.
- To provide knowledge on electrical safety.
- To make students understand various biomedical Instruments used for non-electrical parameter measurement.
- To make students familiarized with various medical imaging systems.
- To provide knowledge on the fundamental concept of life assisting and therapeutic devices.

UNIT I BASIC CONCEPTS OF MEDICAL INSTRUMENTATION 9

Medical Instrumentation systems – Classification of Biomedical instruments –Transducers Selection criteria – Bio-potentials – Electrical activity of excitable cells – Bio-potential Electrodes – Types of electrodes - Electrode behavior and circuit models.

UNIT II BIOMEDICAL SIGNAL ACQUISITION AND ANALYSIS 9

Types and Classification of biological signals – Electrical parameters acquisition: Origin, recording schemes – ECG, EEG, EMG, ERG – Lead systems and recording methods – Typical waveforms – Noise and artifacts – Electrical safety: Physiological Effect of Electrical Current, shock hazards – leakage current.

UNIT III MEASUREMENT OF NON ELECTRICAL PARAMETERS 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, fingertip oximeter.

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 THERAPEUTIC DEVICES AND TELEMETRY **9**

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

TOTAL : 45 PERIODS

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.

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.
3. James E.Moore Jr, Duncan J. Maitland, "Biomedical Technology and Devices", CRC press, 2nd Edition 2013

REFERENCE BOOKS:

1. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 3rd Edition, New Delhi, 2014.
2. Joseph J. Carr and John M. Brown," Introduction to Biomedical Equipment Technology", John Wiley and sons, 4th Edition, New York, 2000.
3. Monte Ross, "Laser Applications", McGraw-Hill, 1968. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", 2nd Edition, Boca Raton, CRC Press LLC, 2000.
4. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., "Health Care Systems, Technology and echniques", Springer, 1st Edition, 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	PSO 1	PSO 2	PSO 3
CO002.1	3		3			2				1			3	2	
CO002.2	2	2							3	1			3	2	
CO002.3			3							1		2	3	2	
CO002.4				3	3				2	1		2	3	2	
CO002.5	3	3						2	2	1		2	3	2	
CO002.6	3				2	2				1			3	2	
CO002	2.8	2.5	3	3	2.5	2		2	2.3	1		2	3	2	

EI5003	FIBRE OPTICS AND LASER INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To provide knowledge on the theory behind light propagation in optical fibers, types of optical fibers, dispersion characteristics, and losses associated with optical fibers.
2. To provide an overview of recent advances in fiber optic sensor technology.
3. To provide knowledge on principles of laser generation, laser systems and its types.
4. To emphasize how lasers have been used for industrial applications.
5. To provide knowledge on the fundamentals of holography and medical applications of lasers.

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 fibers and their properties, Fiber manufacturing – mechanical and transmission characteristics – Connectors & splicers – Fiber termination – Optical sources – Optical detectors.

UNIT II FIBER OPTIC SENSORS 9

Fiber optic sensors – Fiber optic instrumentation system for measurement of fiber characteristics – Different types of modulators – Interferometric method for measurement of length – Measurement of pressure, temperature, electric field, liquid level and strain.

UNIT III LASER FUNDAMENTALS 9

Fundamental characteristics of lasers – Three level and four level lasers – Properties of lasers – Laser modes – Resonator configuration – Q-switching and mode locking – Types of lasers:– Gas lasers, solid lasers, liquid lasers, semiconductor lasers, Excimer lasers & vertical-cavity surface emitting laser (VCSEL).

UNIT IV INDUSTRIAL APPLICATION OF LASERS 9

Applications of Low Power Lasers:- Measurement of distance, length, velocity and acceleration using lasers, & Environmental monitoring using lasers.

Applications of High Power Lasers: Material processing – Laser heating, welding, melting and trimming of material, Material Removal & vaporization.

UNIT V HOLOGRAPHY AND MEDICAL APPLICATIONS OF LASERS 9

Holography – Principles – Methods. – Holographic interferometry and applications, Holography for non-destructive testing – Medical applications of lasers – laser and tissue interaction – Laser instruments for surgery – Safety methods for medical lasers.

TOTAL : 45 PERIODS

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.

TEXT BOOKS:

1. John and Harry, “Industrial lasers and their application”, McGraw-Hill, 2002.
2. Mitschke, F. (2016). Fiber optics: physics and technology. (second Edition). Springer.
3. Keiser, G., “Optical Fiber Communication”, McGraw-Hill, 3rd Edition, 2000.
4. Eric Udd, William B., and Spillman, Jr., “Fiber Optic Sensors: An Introduction for Engineers and Scientists “, John Wiley & Sons, 2011.

REFERENCE BOOKS:

1. Daly, J. C. (2018). Fiber Optics: Second Edition. CRC Press.
2. John F. Ready, "Industrial Applications of Lasers", Academic Press, Digitized in 2008.
3. Monte Ross, "Laser Applications", McGraw-Hill, 1968.
4. Hariharan, P. (2002). Basics of holography. Cambridge 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	PSO 1	PSO 2	PSO 3
CO003.1	3	3						1		1			2		
CO003.2		3	3					2		1		3	2		
CO003.3					3			1		1			2		
CO003.4			3		2			2		1		2	2		
CO003.5					2	3		2		1			2		
CO003.6					**2**			**2**		**1**		**3**	**2**		
CO003	**3**	**3**	**3**		**2.25**	**3**		**1.7**		**1**		**2.7**	**2**		

EI5004	SAFETY INSTRUMENTED SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I INTRODUCTION **9**

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

UNIT II PROTECTION LAYERS AND SAFETY REQUIREMENT SPECIFICATIONS **9**

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

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

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

UNIT IV SYSTEM EVALUATION **9**

Failure Modes, Safe/Dangerous Failures, Detected/Undetected Failures, Metrics: Failure Rate, MTBF, and Life, Degree of 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, 2018.
2. Eric W. Scharpf, Heidi J. Hartmann, Harlod W. Thomas, "Practical SIL target selection: Risk analysis per the IEC 61511 safety Lifecycle", exida2nd Edition 2016.

REFERENCE BOOKS:

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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	PSO 1	PSO 2	PSO 3
CO004.1	2	3	2		3			1	1	2			3	3	2
CO004.2	3	3					3	1		3			3	2	3
CO004.3	1	3	3	3				1					3	3	2
CO004.4						3	3	1					2	2	1
CO004.5		3	3	3				1					3	3	2
CO004.6	2	3	3	2	3			1					3	3	
CO004.7								1		3	1	1	1	2	
CO004	2	3	2.75	2.67	2	3	2	1	1	2.67	1	1	2.57	2.57	2

EI5005	INSTRUMENTATION STANDARDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To impart basic knowledge on Instrumentation standards, principles and its behavior.
- To make the students understand the general requirements for electrical equipment in hazardous location.
- To impart basic knowledge on control valve standards.
- To impart basic knowledge on fossil power plant and nuclear power plant standards.
- To impart basic knowledge on temperature sensor 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. Valve Actuator (ISA 96): 96.01, 96.02, 96.03, 96.04.

UNIT IV ISA STANDARDS - FOSSIL AND NUCLEAR POWER PLANTS **9**

Fossil Power Plant Standards (ISA 77): 77.14, 77.22, 77.30, 77.41, 77.42, 77.44, 77.60, 77.70. Nuclear Power Plant Standards (ISA67): 67.01, 67.02, 67.03, 67.04, 67.06.

UNIT V BS , ISO, IEC, & ANSI **9**

Measurement of Fluid Flow by means of Orifice Plates (ISO 5167/ BSI042) IEC 61131-3 – Programmable Controller – Programming Languages – Specification for Industrial Platinum Resistance Thermometer Sensors (BSI904) – International Thermocouple Reference Tables (BS4937) – Temperature Measurement Thermocouple (ANSIC96.1)

TOTAL : 45 PERIODS

COURSE OUTCOMES (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.

TEXT BOOKS:

1. API Recommended Practice 551, “Process Measurement Instrumentation”, American Petroleum Institute, Washington, D.C., Second Edition, May 2001.
2. API Recommended Practice 554, “Process Instrumentation and Control – 3 parts”, American Petroleum Institute, Washington, D.C., First Edition, October 2008.
3. ISA standard 5, “Documentation of Measurement and Control Instruments and Systems”, ISA, North Carolina, USA.
4. ISA standard 12, “Electrical Equipment for Hazardous Locations”, ISA, North Carolina, USA.

5. ISA standard 20, “Instrument Specification Forms”, ISA, North Carolina, USA.
6. ISA standard 37, “Measurement Transducers”, ISA, North Carolina, USA.
7. ISA standard 75, “Control Valve Standards”, ISA, North Carolina, USA.
8. ISA standard 96, “Valve Actuator”, ISA, North Carolina, USA.
9. ISA standard 77, “Fossil Power Plant Standards”, ISA, North Carolina, USA.
10. ISA standard 67, “Nuclear Power Plant Standards”, ISA, North Carolina, USA.
11. BS EN 60584-1, “Thermocouples - EMF specifications and tolerances”, British Standard, 2013.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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	PSO 1	PSO 2	PSO 3
CO005.1	**2**					**3**	**3**	1		**2**			**2**	**2**	**2**
CO005.2								**1**	**2**				**2**	**2**	**2**
CO005.3					**3**	**2**		1					**2**	**2**	**2**
CO005.4				**3**	**3**		**2**	1							
CO005.5		**3**	**3**					1					**2**	**2**	
CO005.6				**3**				**1**							
CO005	**2**	**3**	**3**	**3**	**3**	**2.5**	**2.5**	**1**	**2**	**2**			**2**	**2**	**3**

EI5006	FUNDAMENTALS OF NANO SCIENCE AND MEMS	L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To provide wide information on nanomaterials, its properties and its applications.
2. To understand the various methods for synthesis of nano materials.
3. To understand the methods involved in preparation of nano scale devices.
4. To analyze the toxic effects of nanomaterials along with nano safety.
5. To understand and apply the various instrumentation techniques for characterization of nano materials

UNIT I INTRODUCTION TO NANOSCIENCE AND NANOTECHNOLOGY **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.

UNIT II SYNTHESIS TECHNIQUES **9**

Bottom-up approach: – Mechanical Milling – planetary ball mill – ball materials – vibratory mill. Top-down Approach: - Physical Vapour Deposition (PVD): – Inert Gas Condensation (IGC), Laser Ablation & Wire Explosion. - Chemical Vapour Deposition (CVD):- Thermally activated CVD & Plasma Enhanced CVD – Epitaxy:- Metal Organic Chemical Vapor Deposition (MOCVD), Molecular Beam Epitaxy (MBE) & Atomic Layer Deposition (ALD).

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES **9**

Direct and Indirect writing - Photolithography – UV lithography - electron beam lithography - Xray Lithography - Ion Beam Lithography, Atomic Force Microscope based Lithography – Scanning Tunneling Microscope based Lithography - Dip pen lithography.

UNIT IV NANOSAFETY AND CLEAN ROOM PRINCIPLES **9**

Nanotoxicology – Nano safety – Environmental effects - Clean rooms specifications – Clean Room Contaminants – Clean room principles:- Laminar flow and turbulent flow clean rooms – Clean Room Construction and Design:- Bay Chase Clean Room, Ball Room Clean Room & Micro Environment Clean Room.

UNIT V INSTRUMENTS FOR CHARACTERIZATION OF NANOMATERIALS 9

X-Ray Diffraction technique - Scanning Electron Microscopy – Transmission Electron Microscopy – Atomic Force Microscope - Scanning Tunneling Microscope - Nano indentation system.

TOTAL : 45 PERIODS

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.

TEXT BOOKS:

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

REFERENCE BOOKS:

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. AkhleshLakhtakia (Editor), "The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations", Prentice-Hall of India (P) 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	PSO 1	PSO 2	PSO 3
CO006.1	3	**3**						**1**		**1**					
CO006.2					**3**			**1**	**3**	**1**		**3**			
CO006.3			**3**		**3**			**1**	**3**	**1**		**3**		**2**	
CO006.4							**3**	**1**		**1**					
CO006.5					**3**			**1**	**3**	**1**		**3**			
CO006.6		**2**						**1**		**1**		**3**	**3**		
CO006	**3**	**2.5**	**3**		**3**		**3**	**1**	**3**	**1**		**3**	**3**	**2**	

EI5007	MODERN CONTROL THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I NON-LINEAR SYSTEMS 9

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

UNIT II STABILITY OF NON-LINEAR SYSTEMS 9

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

UNIT III MODELLING AND CONTROL OF NON-LINEAR SYSTEMS 9

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

UNIT IV CHAOS AND BIFURCATION BEHAVIOR 9

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

UNIT V LINEARIZATION 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES(COs)

1. Ability to find numerical solution for non-linear differential equations.
2. Ability to analyze and interpret the stability of the nonlinear systems.
3. Ability to apply mathematical knowledge and basics of science and engineering to develop model for non-linear systems.
4. Ability to understand the bifurcation behavior of non-linear systems.
5. Ability to linearize non-linear systems for developing linear control.
6. Ability to use appropriate software tools for analysis of non-linear systems.

TEXT BOOKS:

1. Hangos, K.M., Bokor, J., and Szederkrnyi, G., "Analysis and control of Non-linear Process systems".Springer 2016.
2. Gopal,M., "Digital Control and State Variable Methods: Conventional and Intelligent Control Systems", Fourth Edition, Tata Mc-Graw Hill, 2012.

REFERENCE BOOKS:

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", Third 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, Second Edition, CRC Press, 2010.
7. NPTEL Lecture on "Non-linear system Analysis" by Prof. Laxmidhar Behera, IIT Kanpur.

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	PSO 1	PSO 2	PSO 3
CO007.1	**3**		**3**					1		1				**3**	
CO007.2		**3**						1		1				**3**	
CO007.3	**3**			**3**				1		1				**3**	
CO007.4	**3**			**3**				1		1				**3**	
CO007.5	**3**		**3**					1		1				**3**	
CO007.6					**3**			**1**		**1**				**3**	
CO007	**3**	**3**	**2**	**2**	**2**			**1**		**1**				**3**	

EI5008	ADVANCED TOPICS IN PID CONTROL	L	T	P	C
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To provide an overview of the features associated with Industrial type PID controller.
- To make the students understand the various PID Controller Design methods and about PID stabilization for Linear Time-invariant models.
- To develop the skills needed to design adaptive and non-linear PID control schemes.
- To provide basic knowledge about Fractional-order systems and Fractional-order- controller and to lay the foundation for the systematic approach to Design controller for fractional order systems.

UNIT I INTRODUCTION **9**

Evolution of PID controller – PID Controller Structures – PID Implementation Issues – Tuning of 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.

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 & implement a P/PI/PID Controllers for a given process and validate through simulations
3. Ability to design and implement optimal/ robust PID controller for a given process and validate through simulations.
4. Ability to design and implement adaptive PID controllers and PID types Fuzzy Logic Controller for a given process and validate through simulations.
5. Ability to analyze fractional-order systems, fractional-order- controller and design a suitable fractional order P/PI/PID controller for fractional order and Integer order systems.
6. Ability to analyze various PID control schemes and recommend the right control strategy for a given application in accordance with the industrial requirement.
7. Ability to present the results in written and oral forms.

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.

REFERENCE BOOKS:

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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	PSO 1	PSO 2	PSO 3
CO008.1	3							1						3	
CO008.2	3		3		3			1						3	
CO008.3	3		3		3			1						3	
CO008.4	3		3		3			1						3	
CO008.5	3	3	3	3	3			1						3	
CO008.6	3			3				1						3	
CO008.7								1		3					
CO008	3	3	3	3	3			1		3				3	

EI5009	MODEL PREDICTIVE CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I MODEL PREDICTIVE CONTROL SCHEMES 9

Introduction to Model Predictive Control - Model Predictive Control Elements - Model Predictive Control Schemes: Dynamic Matrix Control and Model Algorithmic Control – Case Studies

UNIT II GENERALIZED PREDICTIVE CONTROL SCHEME 9

Generalized Predictive Control Scheme – Simple Implementation of Generalized Predictive Control Scheme for Industrial Processes – Multivariable Generalized Predictive Control Scheme – Case Studies

UNIT III STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME 9

State Space Model Based Predictive Control Scheme - Review of Kalman Update based filters – State Observer Based Model Predictive Control Schemes – Case Studies

UNIT IV CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME 9

Constraints Handling: Amplitude Constraints and Rate Constraints – Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

UNIT V ADVANCED TOPICS IN MPC 9

Robust Model Predictive Control Scheme – Adaptive Model Predictive Control Scheme – 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 describe the advantages and disadvantages of various MPC schemes.
2. Ability to formulate and solve unconstrained/constrained model predictive control schemes for a given process.
3. Ability to implementModel Predictive Controlalgorithms in MATLAB/SCILAB and validate through simulations.
4. Ability to design and implement robust, adaptive MPC schemes on the simulated model of benchmark processes
5. Ability to Identify, formulate and solve problems in the field of Process Control domain using MPC.
6. Ability to present the results in written and oral forms.

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.

REFERENCE BOOKS:

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	PSO 1	PSO 2	PSO 3
CO009.1	**3**							1						**3**	
CO009.2	**3**	**3**						1						**3**	
CO009.3	**3**				**3**			1						**3**	
CO009.4	**3**		**3**		**3**			1						**3**	
CO009.5	**3**	**3**	**3**	**3**	**3**			1						**3**	
CO009.6								1		**3**					
CO009	**3**	**3**	**2**	**3**	**3**			1		**3**				**3**	

EI5010	FAULT DETECTION AND DIAGNOSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I INTRODUCTION & ANALYTICAL REDUNDANCY CONCEPTS 9

Introduction – Types of faults and different tasks of Fault Diagnosis and Implementation – Different approaches to FDD: Model free and Model based approaches-Introduction- Mathematical representation of Faults and Disturbances: Additive and Multiplicative types – 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

COURSE OUTCOMES (COs)

1. Ability to describe the different approaches to Fault Detection and Diagnosis.
2. Ability to detect faults using Limit Checking, Parameter estimation methods and Principle Component Analysis.
3. Ability to detect sensors and actuators faults using structured residual approach as well as directional structured residual approach.
4. Ability to detect and isolate faults in sensor and actuators using Generalized Likelihood Ratio and Marginalized Likelihood Ratio based Approaches.
5. Ability to detect, quantify and compensate stiction in control valves.
6. Ability to present the results in written and oral forms

TEXT BOOKS

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

REFERENCE BOOKS

1. Steven X. Ding, "Model based Fault Diagnosis Techniques: Schemes, Algorithms, and Tools", Springer Publication, 2012.
2. Hassan Noura, Didier Theilliol, Jean-Christophe Ponsart and Abbas Chamseddine, "Fault-Tolerant Control Systems: Design and Practical Applications", Springer Publication, 2009.
3. Blanke, Mogens; Kinnaert, Michel; Lunze, Jan; Staroswiecki, Marcel, "Diagnosis and Fault Tolerant Control", Springer, 2015.
4. Ali Ahammad Shoukat Choudhury, Sirish L. Shah and Nina F. Thornhill, "Diagnosis of Process Nonlinearities and Valve Stiction: Data Driven Approaches", Springer, 2008.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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	PSO 1	PSO 2	PSO 3
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CO0010.4	3	2	3	2				1						3	
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CO0010.6								1		3					
CO0010	3	2	3	2				1		3				3	

EI5011	CYBER SECURITY FOR INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I INTRODUCTION **9**

Industrial security environment-Industrial automation and control system (IACS) culture Vs IT Paradigms-Cyberattacks: Threat sources and steps to successful cyberattacks

UNIT II RISK ANALYSIS **9**

Risk identification, classification and assessment, Addressing risk: Cybersecurity Management System (CSMS), organizational security, physical and environmental security, network segmentation, access control, risk management and implementation.

UNIT III ACCESSING THE CYBERSECURITY OF IACS **9**

Identifying the scope of the IACS- generation of cybersecurity information-identification of vulnerabilities- risk assessment-evaluation of realistic threat scenarios- Gap assessment-capturing Ethernet traffic- documentation of assessment results

UNIT IV CYBERSECURITY DESIGN AND IMPLEMENTATION **9**

Cybersecurity lifecycle- conceptual design process- detailed design process- firewall design- remote access

design- intrusion detection design

UNIT V TESTING AND MAINTENANCE **9**

Developing test plans- cybersecurity factory acceptance testing- site acceptance testing- network and application diagnostics and troubleshooting- cybersecurity audit procedure- IACS incident response.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to apply basis of science and engineering to understand Industrial security environment and cyberattacks.
2. Ability to analyze and assess risks in the industrial environment
3. Ability to access the cybersecurity of IACS
4. Ability to design and implement cyber security
5. Ability to test and troubleshoot the industrial network security system.
6. Ability to understand, investigate and explore feasible solution for a moderate industrial problem.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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	PSO 1	PSO 2	PSO 3
CO011.1	**3**							1		1					
CO011.2	**3**	**3**						1		1					**3**
CO011.3	**3**	**3**						1		1					**3**
CO011.4	**3**		**3**		**3**			1		1					**3**
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CO011.6	**3**		**3**	**3**				1		1		**3**			**3**
CO011	**3**	**3**	**3**	**3**	**3**			1		1		**3**			**3**

EI5012	CYBER PHYSICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the nature of continuous and discrete systems
- To develop synchronous and asynchronous model of processes
- To specify both safety and liveness requirements in temporal logic and to debug the correctness of the protocol using model checking
- To develop and analyze model of timed and hybrid systems.

UNIT I INTRODUCTION **9**

Introduction-key features of cyber physical systems- Continuous dynamics: Newtonian mechanicsactor models-properties of systems-feedback control-Discrete dynamics: Discrete systems- Finite state machines

UNIT II SYNCHRONOUS AND ASYNCHRONOUS MODEL **9**

Synchronous model: Reactive components-properties of components-composing componentssynchronous design, Asynchronous model- asynchronous processes- asynchronous design primitives- coordination protocols.

UNIT III SAFETY AND LIVENESS REQUIREMENT **9**

Safety specifications- verifying invariants- Enumerative search- Temporal logic- Model checking-reachability analysis- proving liveness.

UNIT IV TIMED MODEL AND REAL-TIME SCHEDULING **9**

Timed processes- Timing based protocols:Timing-Based Distributed Coordination-Audio Control Protocol- Timed automata:Model of Timed Automata-Region Equivalence-Matrix-Based Representation for Symbolic Analysis, Real-time scheduling.

UNIT V HYBRID SYSTEMS **9**

Classes of Hybrid systems-Hybrid dynamic models:Hybrid Processes-Process Composition-Zeno Behaviors-Stability- designing hybrid systems- linear hybrid automata

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand knowledge, opportunities, challenges and Logical Foundations of Cyber Physical Systems.
2. Ability to develop model for synchronous, asynchronous, continuous and discrete systems.
3. Ability to identify safety specifications and critical properties of Cyber Physical Systems.
4. Ability to design and analyze the stability of hybrid systems.
5. Ability to apply automata for timed systems.

TEXT BOOKS:

1. Rajeev Alur, Principles of cyber-physical systems, The MIT press, 2015.
2. E. A. Lee and S. A. Seshia, Introduction to Embedded Systems - A Cyber-Physical Systems Approach, Lulu.com, First Edition, Jan 2013.

REFERENCE BOOKS:

1. Sang C.Suh , U.JohnTanik and John N.Carbone , Applied Cyber-Physical systems, Springer,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	PSO 1	PSO 2	PSO 3
CO012.1	3							1		1				3	
CO012.2	3	3	2		3			1		1				3	
CO012.3	3		3					1		1				3	
CO012.4	3	3	3					1		1				3	
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CO012	3	3	2.7	3	3			1		1				3	

EI5013	CONTROL VALVES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basic terminologies and types of control valves and actuators
- To understand the characteristics of control valves
- To select control valves and actuators based on the requirement
- To analyze various control valve problems and to test the quality of valves

UNIT I INTRODUCTION TO CONTROL VALVES 9

Basics Of Control Valves, Importance of Control Valve In Process Industry, Basic Terminologies, Sliding Stem Control Valve, Rotatory Stem Control Valve Terminologies, Types Of Control Valves- Globe Valve, Sanitary Valves, Rotary Valves. Valve Trim Types.

UNIT II ACTUATORS AND CONTROL VALVE ACCESSORIES 9

Actuators – Schematics, Working of Actuator, Types of Actuators- Hydraulic, Pneumatic, Electrical Actuators. Pneumatic Actuator: Linear- Spring &Diaphragm, Piston Type, and Rotary: Scotch Yoke, Rack and Pinion. Valve Body Bonnets, Control Valve Packing, Control Valve Accessories- Positioner and It Types, I/P Coil, Volume Boosters, Position Transmitters, Limit Switches, Solenoid Valves. Special Control Valves.

UNIT III VALVE CHARACTERISTICS, SIZING AND SELECTION 9

Valve Performance And Characteristics For Different Types Of Valves, Dead Band – Causes, Effects, Performance Test, Valve Response Time- Importance Of Supply Pressure, Dead Time And Solutions To Minimize Dead Time. Valve Sizing, Actuator Sizing, Valve Selection, Actuator Selection.

UNIT IV COMMON CONTROL VALVE PROBLEMS 9

Cavitation and Flashing, Control Valve Noise- Noise Prediction and Reduction Techniques, General Valve Problems Valve Passing, Valve Stuck Up, Calibration Issues, Packing Leak, Insufficient Flow. Control Valve Installation and Commissioning Guidelines, Environmental and Application Consideration for valve selection.

UNIT V QUALITY TESTS AND STANDARDS 9

Quality Check Of Control Valves, Non-Destructive Testing: Radiography Test, Ultrasonic Test, Leak And Liquid Penetrating Test, Magnetic Particle Testing. Factory Acceptance Test, Control Valve And Actuator Maintenance, Control Valve Diagnostics, ISA 75.25.01: 2000: Test Procedure For Control Valves Response Measurement From Step Inputs,IEC60534-4 : 2006: Industrial Process Control Valves - Inspection &Routine Testing.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to understand terminologies associated with control valves.
2. Ability to determine the characteristic features of different types of control valves.
3. Ability to compare the merits and limitations of different types of actuators.
4. Ability to analyse and recommend appropriate control valves characteristics for a given application.
5. Ability to carry out design calculations for control valves.
6. Ability to evaluate the common problems associated with control valves outline.
7. Ability to comment on different quality testing methods for control valves.
8. Ability to interpret the industry popular standards for control valves diagnostics and testing procedure.

TEXT BOOKS:

1. Control system components, M.D.Desai, PHI Learning.
2. ISA Handbook for control valves, James W Hutchison, ISA

REFERENCE BOOKS:

1. Instrumentation Engineer's Handbook, B.G.Liptak, Chilton Book co.,Philadelphia.
2. Valve selection Handbook- R.W.Zappe Gulf Publishing Co.,Huston.

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	PSO 1	PSO 2	PSO 3
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CO013.3	3							1		1					
CO013.4	3	3		3				1		1				3	
CO013.5	3		3	3	3			1		1				3	
CO013.6	3	3		3				1		1		3			
CO013.7	3							1		1				3	
CO013.8	3			3	3			1		1		3		3	
CO013	3	3	3	3	3			1		1		3		3	

EI5014	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give an introduction on several fundamental concepts and methods for machine learning.
- To familiarize with some basic learning algorithms and techniques and their applications.
- To provide the knowledge related to processing, analyzing and handling data sets.
- To illustrate the typical applications of various clustering-based learning algorithms.

UNIT I INTRODUCTION TO MACHINE LEARNING 9

Objectives of machine learning – Human learning/ Machine learning – Types of Machine learning:- Supervised Learning – Unsupervised learning – Regression – Classification – The Machine Learning Process:- Data Collection and Preparation – Feature Selection – Algorithm Choice – Parameter and Model Selection – Training – Evaluation – Bias-Variance Tradeoff – Underfitting and Over fitting Problems.

UNIT II DATA PREPROCESSING 9

Data quality – Data preprocessing: - Data Cleaning:– Handling missing data and noisy data – Data integration:- Redundancy and correlation analysis – Continuous and Categorical Variables – Data Reduction:- Dimensionality reduction (Linear Discriminant Analysis – Principal Components Analysis – Factor Analysis – Independent Components Analysis)

UNIT III SUPERVISED LEARNING 9

Linearly separable and nonlinearly separable populations – K-Nearest Neighbor – Logistic Regression – Radial Basis Function Network – Support Vector Machines: - Kernels – Risk and Loss Functions - Support Vector Machine Algorithm – Multi Class Classification – Support Vector Regression.

UNIT IV CLUSTERING AND UNSUPERVISED LEARNING 9

Introduction – Clustering:- Partitioning Methods:- K-means algorithm – Mean Shift Clustering – Hierarchical clustering – Clustering using Gaussian Mixture Models – Clustering High-Dimensional Data:- Problems – Challenges

UNIT V NEURAL NETWORKS 9

Multi Layer Perceptron – Back propagation Learning Algorithm – Neural Network fundamentals – Activation functions – Types of Loss Function – Optimization: Gradient Descent Algorithm – Stochastic Gradient Descent – Batch Normalization and Dropouts – Applications of Neural Network.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to understand the basic theory underlying machine learning.
2. Ability to understand a range of machine learning algorithms along with their strengths and weaknesses.
3. Ability to formulate machine learning problems corresponding to different applications.
4. Ability to apply machine learning algorithms to solve problems of moderate complexity.
5. Ability to read current research papers and understand the issues raised by current research.
6. Able to Explore the data by understanding the concepts of exploratory data analysis.

TEXT BOOKS:

1. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer Texts in Statistics,2013.
2. Thomas A. Runkler, Data Analytics: Models and Algorithms for Intelligent Data Analysis, Springer Vieweg, 2nd Edition,2016.

REFERENCE BOOKS:

1. Jiawei Han, MichelineKamber, Jian Pei, Data Mining: Concepts and Techniques: Concepts and Techniques, Elsevier, 2011.
2. Stephen Marsland, Machine Learning: An Algorithmic Perspective
3. Ian H. Witten, Eibe Frank, Mark A. Hall, Data Mining: Practical Machine Learning Tools and Techniques, Elsevier, 2011
4. Ferdinand van der Heijden, Robert Duin, Dick de Ridder, David M. J. Tax, Classification, Parameter Estimation and State Estimation: An Engineering Approach Using MATLAB, John Wiley & Sons, 2005.

MAPPING COURSE OUTCOMES WITH PROGRAMMEOUTCOMES

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	PSO 1	PSO 2	PSO 3
CO014.1	3				2			1		1					
CO014.2	3	3			2			1		1					
CO014.3	3	3	3		2			1		1				3	
CO014.4	3	3						1		1					
CO014.5	3	3	3					1		1		3		3	
CO014.6	2	3	2	2	3	2		3		1	2	3			
CO014	2.8	3	2.7	2	2.3	2		1.3		1	2	3		3	

EI5015	MICRO CONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the concept of microcontroller based system development
- To familiarize the Clocking and Memory Circuits
- To provide the Knowledge of Communication Modules
- To impart knowledge on RTOS based system Design
- To introduce the concept of Embedded Systems for IOT

UNIT I EMBEDDED HARDWARE DESIGN 9

Power supply - reset circuit - programming interface - GPIO options (slew rate, hysteresis, source, sink capability)- Digital input interfacing and protection - High side and low side drivers - unused pins - Internal ADC options - Brown out reset - optimizing power consumption.

UNIT II CLOCKING AND MEMORY 9

Internal vs External clock - PLL - Clocking tree - System clock/Peripheral clock - Frequency modulated clock - Progressive clock switch - Flash memory - Memory Management unit - Crossbar switch - Caching modes (write through, write back, inhibit) - Flushing vs Invalidating cache - Accessing External Memories

- EEPROM cycles - Organization of C variables in memory.

UNIT III COMMUNICATION MODULES 9

Circuit design, clock and driver algorithm, Inter-Integrated Circuits (I2C) - Serial Communication Using SPI - Differences between SPI and I2C.- UART - Controller Area Network (CAN) - OSI Architecture - PHY (Ethernet - Wifi).

UNIT IV RTOS BASED SYSTEM DESIGN 9

Non RTOS - Interrupts - Nested Interrupts - System Tick - RTOS - Scheduler code - Tasks - Idle task – co-routine - Stack management - Resources - Semaphores - Mutex - Reentrancy - Priority Inversion - Priority Inheritance - Priority Ceiling -RAM management – Watchdog.

UNIT V EMBEDDED SYSTEMS FOR IOT IN LINUX 9

Raspberry Pi - Introduction to Linux - Process - Thread Safety - Ethernet TCP/IP Stack - Socket programming - Security Introduction - Demo project on IoT using Embedded systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to determine the constitutional components of a microcomputer system and their significance.
2. Ability to select suitable communication protocols in accordance with the application in hand.
3. Ability to analyze the functioning of various memory modules.
4. Ability to differentiate the operational characteristics of Non-RTOS and RTOS based systems and use them efficiently in design environments.
5. Ability to infer the concept of IoT and demonstrate its power in real world applications.
6. Ability to formulate design strategies for embedded applications.

TEXT BOOKS:

1. Dawoud Shenouda Dawoud R. Peplow, “Digital System Design — Use of Microcontroller” RiverPublishers, 2010
2. MPC5777C Microcontroller Data Sheet, NXP Semiconductors. Rev. 13, 08/2018.
3. Raj Kamal, “Embedded Systems – Architecture, Programming and Design”, Third Edition, McGraw Hill Education (India) Private Limited, 2015.

REFERENCE BOOKS:

1. Peatman, J.B., “Design with PIC Micro Controllers”, Pearson Education, 3rd Edition, 2004.
2. Datasheet of Microcontroller based on ARM CORTEX M4, NXP Semiconductors, Rev. 7, 05/2017
3. AVR Microcontroller Hardware Design Considerations, Microchip Technology Inc. 2017
4. https://www.nxp.com/docs/en/application-note/AN5408.pdf
5. https://www.nxp.com/docs/en/application-note/AN4812.pdf
6. https://www.instructables.com/id/Complete-tutorial-for-raspberry-pi-beginners

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	PSO 1	PSO 2	PSO 3
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CO015.4	3			3				1		1				3	
CO015.5	3				3			1		1		3		3	
CO015.6	3	3	3	3	3			1		1				3	
CO015	3	3	3	2.75	3			1		1		3		3	

EI5016	INTRODUCTION TO IMAGE AND VIDEO PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study the formation of an image and its acquisition
- To introduce the application of transforms in image processing
- To study techniques for improving quality of information in images
- To get familiarized with image and video processing techniques
- To apply image and video processing in industrial applications

UNIT I DIGITAL IMAGE FUNDAMENTALS **9**

Elements of digital image processing systems – Digital Image Representation- Elements of visual perception – Image acquisition - Image sampling and Quantization – Image geometry – Discrete Image Transforms- Properties- Color image fundamentals:- RGB, HSI models.

UNIT II IMAGE PREPROCESSING AND ENHANCEMENT **9**

Point processing methods:- Contrast stretching – Gray level slicing- Histograms, Histogram equalization and specification techniques, Spatial filtering, Directional Smoothing, Median, Geometric mean, and Harmonic mean filters - Color image enhancement.

UNIT III IMAGE SEGMENTATION AND ANALYSIS **9**

Detection of Discontinuities, Edge linking, Boundary detection, Thresholding – Region oriented segmentation-Watershed segmentation – Object detection - Pattern Recognition – Classification.

UNIT IV DIGITAL VIDEO PROCESSING **9**

Video acquisition - Inter-frame processing, Motion Estimation and Compensation – Filtering – Video segmentation – Tracking by detection – Tracking multiple objects.

UNIT V APPLICATIONS OF IMAGE AND VIDEO PROCESSING **9**

Applications in measurements, manufacturing, medicine, agriculture and food industry – Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to understand the technical terms associated with image and video processing.
2. Ability to select the appropriate preprocessing techniques for manipulation of images
3. Ability to utilize the different approaches of image enhancement, segmentation and analysis techniques
4. Ability to use appropriate software tools(Example: Matlab, Open CV and Python) for image and video processing
5. Ability to apply different digital video processing methods
6. Ability to design automated techniques for image based applications

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, , Digital Image Processing‘, Pearson, Education, Inc., Second Edition, 2004.
2. Anil K. Jain, Fundamentals of Digital Image Processing‘, Pearson Education, Inc., 2002.
3. Thomas. B. Moeslund, “Introduction to Video and Image Processing”, Springer, 2012.

REFERENCE BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB" Pearson Education, Inc., 2004.
2. John W. Woods, "Multidimensional Signal, Image and Video Processing", Elsevier, 2nd Edition 2011.
3. William K. Pratt, "Digital Image Processing", John Wiley, New York, 2002.
4. Alan C. Bovik, "Handbook of image and video processing" Elsevier Academic press, 2005.
5. A. Murat Tekalp, "Digital Video Processing", Prentice Hall, 2nd Edition, 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	PSO 1	PSO 2	PSO 3
CO016.1	3							1		1				3	
CO016.2	3			2	3			1		1				3	
CO016.3	3			2	3			1		1				3	
CO016.4	3			2	3			1		1		3		3	
CO016.5	3		3	2	3			1		1				3	
CO016.6	3		2	2	3			1		1				3	
CO016	3		2.5	2	3			1		1		3		3	

EI5017	PRINICIPLES OF COMMUNICATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the students to the principles of analog and digital communication.
- To impart knowledge on the waveform encoding techniques.
- To facilitate the students in analyzing the performance of transmitters and receivers.
- To familiarize the students with the principles of multi-user communication systems.

UNIT I ANALOG MODULATION SCHEMES 9

Modulation - Amplitude modulation:-DSB-FC, DSB-SC and SSB-SC - Frequency modulation and Phase Modulation – Time domain representation – Spectral characteristics – Block diagram of AM Transmitters and Receivers – Concept of Super heterodyning.

UNIT II WAVEFORM ENCODING TECHNIQUES 9

Sampling theorem, Types of Sampling, Quantization – Principles of PAM, PPM, PWM – Pulse code Modulation, DPCM, Quantization noise in PCM – Delta Modulation, ADM.

UNIT III LINE CODING TECHNIQUES AND ERROR CORRECTION 9

Properties of line codes, UniPolar / Bipolar, RZ/NRZ and Manchester – Time domain representation - M-ary schemes, Error detection and correction:- Hamming code and Linear block codes - Matched filter and Correlator.

UNIT IV PASSBAND DIGITAL MODULATION 9

BASK, BFSK, BPSK, QPSK and QAM – Signal space representation – Probability of error for ASK, FSK, PSK – Comparison of the schemes – Coherent/Non-Coherent reception.

UNIT V MULTIPLEXING AND MULTIPLE ACCESS SCHEMES 9

Concept of multiplexing: FDM and TDM. Multiple Access: FDMA, TDMA and CDMA – Application to Mobile communication and Satellite communication.

TOTAL : 45 PERIODS

COURSE OUTCOMES (COs)

1. Ability to gain knowledge about the principles of communication techniques.
2. Ability to understand the importance of each type of modulation system for specific applications
3. Ability to capable of configuring Source coding schemes
4. Ability to analyze various Band pass signaling schemes and compare their performance
5. Ability to gain knowledge on multiple access schemes.
6. Get acquainted with the principle and operation of mobile and satellite communication systems.

TEXT BOOKS:

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

REFERENCE BOOKS:

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 MasoudSalehi, "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	PSO 1	PSO 2	PSO 3
CO017.1	3				3			1		1				3	
CO017.2	3			2	3			1		1				3	
CO017.3	3			2	3			1		1				3	
CO017.4	3			2	3			1		1				3	
CO017.5	3			2	3			1		1				3	
CO017.6	3				3			1		1				3	
CO017	3			2	3			1		1				3	

EI5018	INDUSTRIAL INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To give an overview of the Interconnection and Integration of the Physical World with Cyber Space.
- To provide an insight into Design and Development of IOT application.

UNIT I INTERNET PRINCIPLES **9**

Definition and Characteristics - IoT enabling technologies – Levels of deployment – Domain specific IoTs - SDN and NFV for IoT – ISO/OSI model – MAC address and IP address -Overview of TCP/IP and UDP – - Basics of DNS - Classes of IP addresses - Static and dynamic addressing – Salient features of IPV4 – Specifications of IPV6 and 6LoPAN.

UNIT II PHYSICAL AND LOGICAL DESIGN METHODOLOGIES 9

Requirements and Specifications – Device and Component Integration —Physical design using prototyping boards - Sensors and actuators, choice of processor, interfacing and networking - Logical Design – Open source platforms - Techniques for writing embedded code - Case studies and examples using Python programming and Arduino/Raspberry Pi prototyping boards – IoT application development using Wireless Sensor Networks - Single Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes.

UNIT III PROTOCOLS AND CLOUDS FOR IOT 9

Application layer protocols for IoT – MQTT and –Introduction to cloud storage models and communication APIs – Web application framework – Designing a web API – Web services - IoT device management

UNIT IV INDUSTRIAL IOT AND SECURITY 9

Introduction to the Industrial Internet - Networked Control Systems – Network delay modeling - Architecture and design methodologies for developing IoT application for Networked Control Systems – Example using SCADA system - Software Design Concepts - Middleware IIOT platforms- securing the Industrial Internet- Introduction of Industry 4.0.

UNIT V PROCESS DATA ANALYTICS 9

Process analytics - Dimensions for Characterizing process- process Implementation technology Tools and Use Cases- open source and commercial tools for Process analytics-Big data Analytics for process data - Analyzing Big process data problem – Crowd sourcing and Social BPM - Process data management in the cloud.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Ability to understand the concept of IoT and acquire adequate knowledge over computer networking and communication protocols.
2. Ability to design and develop IoT enabled embedded applications employing wireless sensor networks.
3. Ability to analyze the requirements of a given application and use appropriate protocols and recognize the role of cloud computing and the associated services for IoT based applications.
4. Ability to recognize the technological challenges and opportunities in Industrial IoT design and implementation.
5. Ability to apply the acquired knowledge towards the development of architectural design for IoT enabled Networked Control Systems.
6. Ability to analyze the process data using cloud-based process data management tools.

TEXT BOOKS:

1. ArshdeepBahga and Vijay Madisetti, “Internet of Things A Hands-on Approach”, Universities Press (India), 2015
2. Alasdair Gilchrist," Industry 4.0:The Industrial Internet of Things”, Apress, 2016.

REFERENCE BOOKS:

1 Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley & Sons, 2014

2 Francis Dacosta, “Rethinking the Internet of Things”, Apress Open, 2013.

3 Beheshti, S.-M.-R., Benatallah, B., Sakr, S., Grigori, D., Motahari-Nezhad, H.R., Barukh, M.C., Gater, A., Ryu, S.H."Process Analytics Concepts and Techniques for Querying and Analyzing Process Data" Springer International Publishing Switzerland, 2016.

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	PSO 1	PSO 2	PSO 3
CO018.1	3	2	2	1	2			1	1	2	1	3			
CO018.2	3	3	3	3	3	1	1	1	1	2	1	3	1	3	3
CO018.3	3	3	2	3	3			1	1	2	1	3	1	3	2

CO018.4	3	1	3	2	2	2	2	1	1	2	1	3	1	3	3
CO018.5	3	3	3	3	3	2	2	1	1	2	1	3	1	3	3
CO018.6	3	3	1	2	3			1	1	2	1	3	2	1	1
CO018	3	2.5	2.3	2.3	2.6	1.7	1.7	1	1	2	1	2	1.2	2.6	2.4

EC5651	**DIGITAL VLSI**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To learn the fundamentals of VLSI design
- To understand the IC Manufacturing Process
- To familiarize with VLSI combinational logic circuits design
- To familiarize with VLSI sequential logic circuits design
- To learn the various arithmetic circuits and testing methodologies
- To familiarize with the different FPGA architectures

UNIT I MOS TRANSISTOR PRINCIPLES 9

MOS Technology and VLSI, Pass transistors, NMOS, CMOS Fabrication process and Electrical properties of CMOS circuits and Device modelling. Characteristics of CMOS inverter, Scaling principles and fundamental limits. Propagation Delays, CMOS inverter scaling, Stick diagram, Layout diagrams, Elmore‘s constant, Logical Effort. Case study: Study of technology development in MOS.

UNIT II COMBINATIONAL LOGIC CIRCUITS 9

Static CMOS logic Design, Design techniques to improve the speed, power dissipation of CMOS logic, low power circuit techniques, Ratioed logic .Pass transistor Logic, Transmission CPL, DCVSL, Dynamic CMOS logic, Domino logic, Dual Rail logic, NP CMOS logic and NORA logic

UNIT III SEQUENTIAL LOGIC CIRCUITS 9

Static and Dynamic Latches and Registers, Timing Issues, Pipelines, Clocking strategies, Memory Architectures, and Memory control circuits.

UNIT IV DESIGNING ARITHMETIC BUILDING BLOCKS & TESTING 9

Data path circuits, Architectures for Adders, Accumulators, Multipliers, Barrel Shifters, Need for testing- Manufacturing test principles- Design for testability. Case study: Analysis of area, power and delay for 16 bit adder and 8 bit multiplier.

UNIT V IMPLEMENTATION STRATEGIES 9

Full Custom and Semicustom Design, Standard Cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures. Demo: Complete ASIC flow using Backend tool and fabrication flow Overall case study: Development of IC in commercial aspects (design, testing and fab cost)

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Ability to analyze inverter characteristics and realize modeling of MOS transistors.
2. Ability to design combinational logic using various logic styles, satisfying static and dynamic requirements.
3. Ability to analyze timing issues of sequential logic and design memories.
4. Ability to design data path elements.
5. Ability to compare and analyze FPGA architecture and interconnect methodology.

TEXT BOOK:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated circuits: A Design Perspective", Prentice Hall of India, 2nd Edition, 2003.

REFERENCES

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI DESIGN", A system Perspective, 2nd Edition, Addision Wesley, 2004.
2. A.Pucknell, Kamran Eshraghian, "BASIC VLSI DESIGN", Prentice Hall of India, 3rd Edition, 2007.
3. M.J. Smith, "Application Specific Integrated Circuits", Addison Wesley, 1997.
4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India, 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	PSO 1	PSO 2	PSO 3
CO.1	1	1												3	
CO.2	2	2	3	2								1		3	
CO.3	3	3	2	3	1	1						2		3	
CO.4			1	1								3		3	
CO.5						2					1			3	
CO	2	2	2	2	1	1.5					1	2		3	

EC5075	MIXED SIGNAL IC DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce various functional modules of Mixed Signal ICs
- To introduce the design issues of analog and digital circuit interoperability
- To introduce power management modules in Mixed Signal ICs

UNIT I REFERENCE CIRCUITS 9

Performance Metrics, Current Mirrors, Self Biased Current Reference, startup circuits, VBE based Current Reference, VT Based Current Reference, Band Gap Reference , Supply Independent Biasing, Temperature Independent Biasing, PTAT and CTAT Current Generation, Constant Gm Biasing

UNIT II LOW DROP OUT REGULATORS 9

Performance Metrics, Shunt regulator, Error amplifier, AC Design, Stability, Internal and External Compensation, PSRR – Internal and External compensation circuits, NMOS vs. PMOS regulators.

UNIT III FREQUENCY SYNTHESIZERS 9

Integer-N Phase Lock Loop(PLL), Fractional-N Phase Lock Loop, Delay-Lock Loop (DLL), multiplying-DLL, Injection-locked PLLs, and Sub-sampled PLLs.

UNIT IV ACTIVE FILTER DESIGN 9

Butterworth Filter approximations, Chebyshev Filter approximations, Frequency Transformations, Continuous time filters- Biquad and Ladder based designs, Active RC and Gm-C Filters, Switch Capacitor Filters, Integrator realization and nonidealities

UNIT V CLOCK AND DATA RECOVERY CIRCUITS 9

Channel characteristics-intersymbol interference, eye diagrams, Linear equalization at the transmitter and receiver; CDR Architectures, Trans Impedance Amplifiers, Linear Half Rate CDR Circuits, Wide capture Range CDR Circuits.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

The student who undergoes this course will be able to

1. Design Band gap reference circuits and Low Drop Out regulator for a given specification.

2. Design Frequency synthesizers meeting a given specification.
3. Choose active filter topology and design for a given specification.
4. Design clock generation circuits in the context of high speed I/Os, High speed Broad BandCommunication circuits and Data Conversion Circuits.

TEXT BOOKS:

1. Gabriel.A. Rincon-Mora, "Voltage references from diode to precision higher order bandgapcircuits", Johnwiley& Sons, Inc 2002.
2. Gabriel.A. Rincon-Mora, "Analog IC Design With Low-Dropout Regulators",McGraw-Hill Professional Pub, 2nd Edition, 2014
3. Floyd M. Gardner ,"Phase Lock Techniques" John wiley& Sons, Inc 2005.

REFERENCES:

1. R. Best, Phase-Locked Loops :"Design, Simulation, and Applications", McGraw Hill, 2003.
2. Williams and Taylor, "Electronic Filter Design Handbook", McGraw-Hill, 3rd Edition, 1995
3. Deliyannis, Sun, and Fidler, "Continuous-Time Active Filter Design", CRC Press 1998,
4. BehzadRazavi, "Design of Analog CMOS Integrated Circuits", Tata McGraw Hill, 2001

EC5073	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the relevance of this course to the existing technology through demonstrations, case studies, simulations, contributions of scientist, national/international policies with a futuristic vision along with socio-economic impact and issues
- To tutor the basics of EMI,EMC
- To instill knowledge on the EMI coupling mechanism and its mitigation techniques
- To impart comprehensive insight about the current EMC standards and about various measurement techniques

UNIT I BASIC CONCEPTS 7

Definition of EMI and EMC; Intra and Inter system EMI; Sources and victims of EMI, Conducted and Radiated EMI emission and susceptibility; Transient & ESD; Case Histories; Radiation Hazards to humans.

UNIT II COUPLING MECHANISM 9

Common made coupling; Differential mode coupling; Common impedance coupling; Ground loop coupling; Field to cable coupling; Cable to cable coupling; Power mains and Power supply coupling.

UNIT III EMI MITIGATION TECHNIQUES 10

Shielding – principle, choice of materials for H, E and free space fields, and thickness; EMI gaskets; Bonding; Grounding – circuits, system and cable grounding; Filtering; Transient EMI control devices and applications; PCB Zoning, Component selection, mounting, trace routing.

UNIT IV STANDARDS AND REGULATION 7

Units of EMI; National and International EMI Standardizing Organizations – IEC, ANSI, FCC, CISPR, BIS, CENELEC; FCC standards; EN Emission and Susceptibility standards and specifications; MIL461E Standards.

UNIT V TEST METHODS AND INSTRUMENTATION 12

EMI test sites - Open area site; TEM cell; Shielded chamber; Shielded Anechoic chamber; EMI test receivers; Spectrum Analyzer; Transient EMI Test wave Simulators; EMI coupling Networks - Line impedance Stabilization Networks; Feed through capacitors; Antennas and factors; Current probes and calibration factor; MIL-STD test methods; Civilian STD Test methods, Government policies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Ability to comprehend and appreciate the significance and role of this course in the present contemporary world Upon Completion of the course, the students will be able to:

1. To design a EMI free system.
2. To reduce system level crosstalk.
3. To design high speed Printed Circuit board with minimum interference. CO4: To make our world free from unwanted electromagnetic environment.

TEXT BOOKS:

1. V.P. Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, New York, 2nd Edition, 2010.
2. Henry W.Ott., "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, New York, 2009.

REFERENCES:

1. Don R.J.White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V, 1988
2. Bemhard Keiser, "Principles of Electromagnetic Compatibility", Artech house, Norwood, 3rd Edition, 1987.
3. C.R. Paul, "Introduction to Electromagnetic Compatibility", John Wiley & sons Inc. 2006.

ME5552	METROLOGY AND MEASUREMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Explaining the importance of measurements in engineering and the factors affecting measurements and to estimate measurement uncertainty.
2. Applying the working principle and applications of various linear and angular measuring instruments and basic concepts of measurement of assembly and transmission elements.
3. Interpreting the various tolerance symbols given in engineering drawings to choose the appropriate manufacturing process.
4. Applying the principles and methods of form and surface metrology.
5. Applying the advances in measurements for quality control in manufacturing Industries

UNIT I BASICS OF METROLOGY 9

Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, ISO standards.

UNIT II MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS AND ASSEMBLY AND TRANSMISSION ELEMENTS 9

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope.

Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

UNIT III TOLERANCE ANALYSIS 9

Tolerancing – Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT IV METROLOGY OF SURFACES 9

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations, etc. Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

UNIT V ADVANCES IN METROLOGY 9

Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multisensor CMMs. Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in-process monitoring in production - Computed tomography – White light Scanners.

Total (L: 45) = 45 Periods

COURSE OUTCOMES:

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

1. Describe the importance of measurements in engineering and the factors affecting measurements and to estimate measurement uncertainty.
2. Describe the working principle and applications of various linear and angular measuring instruments and basic concepts of measurement of assembly and transmission elements and select a measuring instrument for the given application.
3. Interpret the various tolerance symbols given in engineering drawings to choose the appropriate manufacturing process.
4. Describe the principles and methods of form and surface metrology and interpret surface metrology related information in Engineering drawings.
5. Describe the advances in measurements for quality control in manufacturing Industries.

TEXTBOOKS:

1. Dotson Connie, “Dimensional Metrology”, Cengage Learning, First edition, 2012.
2. Mark Curtis, Francis T. Farago, “Handbook of Dimensional Measurement”, Industrial Press, Fifth edition, 2013.

REFERENCES:

1. AmmarGrous, J “Applied Metrology for Manufacturing Engineering”, Wiley-ISTE, 2011.
2. Galyer, J.F.W. Charles Reginald Shotbolt, “Metrology for Engineers”, Cengage Learning EMEA; 5th revised edition, 1990.
3. National Physical LaboratoryGuideNo. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. http://www.npl.co.uk. (relevant to syllabus).
4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.
5. Venkateshan, S. P., “Mechanical Measurements”, Second edition, John Wiley &Sons, 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	PSO 1	PSO 2	PSO 3
CO020.1	3	2		2		3	3		2			1	3	3	3
CO020.2	2		3	2					2	2	2		3	3	2
CO020.3	2	2	2	2			2	2			2		3	2	3
CO020.4		3		3	2						2		3	3	3
CO020.5				3	3						2		3	3	2
CO020	2.3	2.3	2.5	2.4	2.5	3	2.5	2	2	2	4	1	3	2.8	2.4

AU5551	AUTOMATIVE ELECTRICAL AND ELECTRONICS SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To define the glossary related to vehicle electrical and electronic system.
2. To understand the need for starter batteries, starter motor and alternator in the vehicle.
3. To differentiate the conventional and modern vehicle architecture and the data transfer among thedifferent electronic control unit using different communication protocols.
4. To list common types of sensor and actuators used in vehicles.
5. To understand networking in vehicles

UNIT I INTRODUCTION AND AUTOMOTIVE BATTERIES 9

Introduction Overview of vehicle electrical systems Electrical circuits Electrical power supply in conventional vehicle Dimensioning of wires Circuit diagrams and symbols - Electromagnetic Compatibility and interference suppression. Batteries – Battery design – Method of operation – Lead acid battery construction – Battery ratings and testing Maintenance -free batteries – Battery – Substitute, versions, special cases

UNIT II STARTING AND CHARGING SYSTEM 9

Alternators – Generation of electrical energy in vehicle physical principles Alternator and voltage regulations versions – power losses – characteristics curve- Alternator operation in the vehicle- Alternator circuitry. Starter Motors – Development and Starting requirements in the IC engines- starter motor design – Starter motor design variations – starter motor control and power circuits

UNIT III IGNITION, LIGHTING AND AUXILLARY SYSTEM 9

Ignitions System - Ignition fundamentals- Electronic ignition- Programmed ignition- Distributor less ignition -Direct ignition - Spark plugs. Automotive lighting Technology – Technical demands – Development of lighting technology- Light sources – physical principles – Front and rear lighting system- Interior lighting system – Special purpose lamps – Adaptive Lighting system - Instrument clusters - Wiper and Washer systems- electric horns

UNIT IV AUTOMOTIVE ELECTRONICS AND SENSORS AND ACTUATORS 9

Automotive Electronics- overview and demands- Basic principles of semiconductor technology -Electronic Components- semiconductor components- Microcontrollers - Sensor-Signal Processing - Data Processing in the vehicle - Glossary for automotive microelectronics. Automotive Sensors – Basics – Sensors : Position, speed, Acceleration/Vibrational , Force/Torque, Flow meters, Gas/ Concentration , Temperature- Measured Quantities, Measuring Principles and automotive applications Automotive Actuators - Electromechanical actuators- Fluid-mechanical actuators- Electrical machines- Direct-current machines- Three-phase machines- Single-phase alternating-current Machines - Duty-type ratings for electrical machines

UNIT V VEHICLE NETWORKING 9

Data transfer between automotive Electronics systems - Basic principles of networking- Network topology- Network organization- OSI reference model- Control mechanisms - communication protocols in embedded systems-- Vehicle Communication Protocols – Cross-system functions - Requirements for bus systems- Classification of bus systems- Applications in the vehicle - Coupling of networks- Examples of networked Vehicles - Bus system- CAN, LIN, Flexray – MOST etc.

TOTAL PERIODS:45

COURSE OUTCOMES:

1. Define the glossary related to vehicle electrical and electronic system
2. Understand the need for starter batteries, starter motor and alternator in the vehicle.
3. Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
4. List common types of sensor and actuators used in vehicles.
5. Understand networking in vehicles.

TEXT BOOKS:

1. Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th Edition, 2007, ISBN No: 978-3-658-01783-5

REFERENCES:

1. Barry Holembeak, "Automotive Electrical and Electronics" , Delmar Publishers, Clifton Park,USA,2010
2. James D Halderman, " Automotive Electrical and Electronics" , Prentice Hall, USA, 2013
3. Tom Denton, "Automotive Electrical and Electronics Systems," Third Edition, 2004, SAE International.
4. William Ribbens, "Understanding Automotive Electronics - An Engineering Perspective," 7th Edition, Elsevier Butterworth-Heinemann Publishers, 2012.

AU5072	VEHICLE CONTROL SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To understand the basics of control system used in automobiles
2. To recognize the electronically controlled system used in driving mechanics.
3. To understand the working principle of driver modelling and power train control systems.
4. To identify the control system used in hybrid and electrical vehicles.
5. To illustrate the need of automated transport systems.

UNIT I INTRODUCTION TO VEHICLE CONTROL SYSTEM 9

Trends, overview and examples of vehicle control system- Sensors, actuators and controller modules- Vehicle communication Network-System Engineering V-diagram- Algorithm Development - Steps in vehicle control system design- Degree of freedom for vehicle control- selection of controlled, manipulated, measured disturbance variables- classification of the variables in various automotive systems like engines, suspension, braking, air conditioning – General types of vehicle controller configurations- Feedback, Inferential, Feed-Forward, Ratio control.

UNIT II CONTROL SCHEMES, CRUISE AND HEADWAY CONTROL 9

Feed - Forward control - Cascade control- Design considerations for cascade control, Time delay compensation, Inferential control- Nonlinear control- Adaptive control etc. Cruise control design- Autonomous cruise control- Anti locking brakes- Traction control system- Vehicle stability control linear and non-linear vehicle model- VSC Design Principles – four-wheel steering – Goals of 4WS Algorithms – active suspensions.

UNIT III DRIVER MODELING AND POWERTRAIN CONTROL SYSTEMS 9

Driving simulators- percentage of road departure- Driver modeling- Transfer function models- Preview/ Predictive models- longitudinal driver models Control oriented engine modeling- Air intake model- Fuel dynamics model- Air Fuel ratio dynamics- Engine Control Loops- Air Fuel Ratio control- EGR Control- Spark Timing control- Idle speed control- Knock control-Adaptive knock control- Combustion torque estimation- Transmission control.

UNIT IV CONTROL OF HYBRID AND FUEL CELL VEHICLES 9

Series-Parallel- Split Hybrid Configurations- Hybrid Vehicle Control Hierarchy- Control Concepts of Series Hybrids- Equivalent Consumption minimization strategy- control concepts for split hybrid modelling of fuel cell systems- fuel stack model- control of fuel cell system.

UNIT V HUMAN FACTORS AND INTELLIGENT TRANSPORT SYSTEM 9

Human factors in vehicle automation- cross over model principle- Risk- Homeostatic Theory- Driving simulators- percentage of road departure Advanced traffic management system- Advanced traveller information system- commercial vehicle operation- Advanced vehicle control system- Preventing collisions- Longitudinal motion control and platoons- Site specific information- comparison of longitudinal control approaches- String stability- Automated steering and lateral control – Lane sensing- automated lane change and follow control.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand the basics of control system used in automobiles
2. Recognize the electronically controlled system used in driving mechanics.
3. Understand the working principle of driver modelling and power train control systems.
4. Identify the control system used in hybrid and electrical vehicles.
5. Illustrate the need of automated transport systems.

TEXT BOOKS:

1. Galip Ulsoy , Automotive Control System, Cambridge University Press, 2012
2. Uwe Kiencke and Lars Nielson, Automotive Control System, SAE Publications, 2006

REFERENCES:

1. Bosch Automotive Handbook, Sixth Edition,2004
2. Benjamin C.Kuo and Farid Golnaraghi, Automatic Control System, John Wiley & Sons, Eight edition, 2003.
3. Katsuhiko Ogata, System Dynamics, Prentice Hall International, Inc. Third Edition,1998
4. Richard C.Dorf and Robert H.Bishop, Modern Control Systems, Pearson Prentice Hall,2008

AU5651	ELECTRIC AND HYBRID VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The course should enable the students to:

1. General aspects of Electric and Hybrid Vehicles (EHV), including architectures, modeling, sizing,subsystem design and hybrid vehicle control.
2. Understand about vehicle dynamics,
3. Design the required energy storage devices,
4. Select the suitable electric propulsion systems and
5. Understand of hybrid electric vehicles.

UNIT NEED FOR ALTERNATIVE SYSTEM 10

Need for hybrid and electric vehicles – main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. Case study on specification of electric and hybrid vehicles.

UNIT II DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency- Electric vehicle chassis and Body Design, Electric Vehicle Recharging and Refueling Systems.

UNIT III ENERGY SOURCES 9

Battery Parameters- - Different types of batteries – Lead Acid- Nickel Metal Hydride - Lithium ion- Sodium based- Metal Air. Battery Modeling- Equivalent circuits, Battery charging- Quick Charging devices. Fuel Cell- Fuel cell Characteristics- Fuel cell types-Half reactions of fuel cell. Ultra capacitors. Battery Management System.

UNIT IV MOTORS AND CONTROLLERS 9

Types of Motors, Characteristic of DC motors, AC single phase and 3-phase motor, PM motors, Switched reluctance motors, Motor Drives and speed controllers, Torque Vectoring, Regenerative Braking. Rectifiers, Inverters, DC/DC converters.

UNIT V SUBSYSTEMS OF HYBRID AND ELECTRIC VEHICLES 8

Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle- Economy of hybrid Vehicles. Steering and Suspension system. Choice of Tires.

TOTAL: 45 PERIODS

OUTCOMES:

The students able to understand

1. Electric and hybrid vehicle operation and architectures
2. Design of hybrid and electric vehicles. iii. Energy requirement for vehicles.
3. Vehicle characteristics, operating modes, and performance parameters of the vehicle
4. Different subsystems of hybrid and electric vehicles

TEXT BOOKS:

1. Iqbal Husain, " Electric and Hybrid Vehicles-Design Fundamentals", CRC Press,2003
2. Mehrdad Ehsani, " Modern Electric, Hybrid Electric and Fuel Cell Vehicles", CRC Press,2005

REFERENCES:

1. James Larminie and John Lowry, "Electric Vehicle Technology Explained " John Wiley & Sons,2003
2. Lino Guzzella, " Vehicle Propulsion System" Springer Publications,2005
3. Ron HodKinson, "Light Weight Electric/ Hybrid Vehicle Design", Butterworth Heinemann Publication,2005

AU5071	AUTOMOTIVE INSTRUMENTATION AND TESTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To provide theoretical and applicative knowledge in automobile test instrumentation.
2. To identify the various instruments for measuring force, torque, pressure, temperature, fluid flow, velocity and rotational speed.
3. To enhance the knowledge of students regarding the experimental methods followed in industries.
4. To familiarize the students on standard test codes.
5. To impart skills on the testing procedure followed for evaluating brake, engine and vehicle.

UNIT I MECHANICAL MEASUREMENT 9

Introduction to measurements – Construction, principle, working of Instruments for measuring force, torque, pressure, temperature, fluid flow, velocity, rotational speed.

UNIT II VIBRATION AND BODY TEST 9

Vibration measurement instrument – accelerometer and signal conditioning. Dynamic simulation sled testing, methodology, vehicle acceleration measurement and documentation. Dolly roll over test, dolly role over fixture, photographic / video coverage. Vehicle roof strength test –. Door system crush test – wind tunnel tests.

UNIT III CRASH AND BRAKE TEST 9

Crash tests –standards – road hazard impact test for wheel and tyre assemblies, test procedures, failure and performance criteria. Bumpers - types of tests, pendulum test, fixed collision barrier test, procedure, performance criteria. Air and hydraulic brake test, air brake actuator, valves test, performance requirements.

UNIT IV ENGINE EXPERIMENTAL TECHNIQUES 9

I.S Code for Engine testing – Instruments for performance testing of engine, Instrumentation for measuring noise, vibration in cylinder, different types of engine tests are performed within the industry.

UNIT V VEHICLE EXPERIMENTAL TECHNIQUES 9

Laboratory tests- test tracks - Endurance Tests - Dynamic cornering fatigue, dynamic radial fatigue tests – procedure, bending moment and radial load calculations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The students will be able to

1. Demonstrate the understanding of engine testing procedures.
2. Develop a measurement strategy for temperature, pressure, mass flow, velocity.
3. Understand sensors and instrumentation, and to analyse and interpret test data.

4. Develop new system that would help in keeping the environment sustainable.
5. Demonstrate the understanding of brake testing procedures

TEXT BOOKS:

1. Crouse W H and Anglin D L., "Automotive Mechanics"' Tata McGraw Hill Publishing Company, 2004.
2. J.G .Giles, Vehicle Operation & Testing.Volume 7 of Automotive technology series, Iliffe,1969
3. Richard D. Atkins, "An Introduction to Engine Testing and Development", SAE International 2009.

REFERENCES:

1. Beckwith TG and Buck N L, "Mechanical Measurements", Addition Wesley Publishing Company Limited, 1995.
2. Jain R K "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 1999.
3. Stockel M W, "Auto Mechanics Fundamentals", Good Heart-Wilcox Co., Inc., 2000.

AE5071	AIRCRAFT SYSTEMS ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To introduce basic concepts of systems engineering and their application to aircraft systems.
2. To acquaint students with design, build, test, operate and disposal phases of aircraft systems and aircraft operating environment system.
3. To impart knowledge on evolution of avionics architecture and arrangements of systems integration of aircraft.
4. To familiarise students with varying system configurations and their compatibility and system evolution considerations.
5. To impart knowledge on fault and failure analysis of aircraft systems and components and types of maintenance procedures

UNIT I INTRODUCTION TO SYSTEMS ENGINEERING 9

Overview-Systems Definition and Concepts-Conceptual System Design- System Engineering Process-Everyday examples of systems-Aircraft systems.

UNIT II DESIGN AND DEVELOPMENT PROCESS 9

Product Life Cycle –Concept Phase-Definition Phase-Design Phase-Build, Test, Operate and Disposal Phase-Whole Life Cycle Tasks-Systems Analysis- Design Drivers in the Project, Product, Operating Environment-Interfaces with the Subsystems.

UNIT III SYSTEM ARCHITECTURES AND INTEGRATION 9

Systems Architectures-Modeling and Trade-Offs- Evolution of Avionics Architectures-Systems Integration Definition- Examples of Systems Integration-Integration Skills-Management of Systems Integration.

UNIT IV PRACTICAL CONSIDERATIONS AND CONFIGURATION CONTROL 9

Stake holders-Communications-Criticism- Configuration Control Process-Portrayal of a SystemVarying Systems Configurations- Compatibility-Factors Affecting Compatibility –Systems
Evolution Considerations and Integration of Aircraft Systems.

UNIT V SYSTEMS RELIABILITY AND MAINTAINABILITY 9

Systems and Components-Analysis-Influence, Economics, Design for Reliability-Fault and Failure Analysis-Case Study-Maintenance Types-Program-Planning and Design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, Students will be able to

1. Acquire knowledge on the basic working principle of hydraulic and pneumatic systems and their components.
2. Identify the types of control systems namely conventional and modern systems and the need to choose them for specific aircraft application.

3. Acquire knowledge on the different types of fuel system used for piston engine and jet engines.
4. Identify the different configurations of aircrafts and compatibility of various systems.
5. Acquire knowledge on the fault and failure analysis of aircraft systems.

TEXT BOOKS:

1. Allan G. Seabridge and Ian Moir, "Design and Development of Aircraft Systems: An Introduction ", (AIAA Education Series), 2004.

REFERENCES:

1. Andrew P. Sage, James E., Jr. Armstrong, "Introduction to Systems Engineering (WileySeries in Systems Engineering and Management)", 2000.
2. Aslaksen, Erik and Rod Belcher, "Systems Engineering", Prentice Hall, 1992.
3. Peter.Sydenham , "Systems Approach to Engineering", Artech house, Inc, London, 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	PSO 1	PSO 2	PSO 3
CO.1	2					2	2	2	2	2	2	2	2		
CO.2	2	1	1			2	2	2	2	2	2	2	2		
CO.3	2					2	2	2	2	2	2	2	2		
CO.4	2	1				2	2	2	2	2	2	2	2		
CO.5	2	1				2	2	2	2	2	2	2	2		
CO	2	1	1			2	2	2	2	2	2	2	2		

AE5072	AVIONICS SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES: Of this course are

1. To introduce the basic of avionics and its need for civil and military aircrafts.
2. To impart knowledge about the avionic architecture and various avionics data buses.
3. To gain more knowledge on various avionics subsystems.
4. To impart knowledge on feedback systems.
5. To gain knowledge in field of navigation systems.

UNIT I INTRODUCTION TO AVIONICS 9

Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies – Introduction to Digital Computer and memories.

UNIT II DIGITAL AVIONICS ARCHITECTURE 9

Avionics system architecture – Data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629 – AFDX.

UNIT III FLIGHT DECKS AND COCKPITS 9

Control and display technologies: CRT, LED, LCD, EL and plasma panel – Touch screen – Direct voice input (DVI) – Civil and Military Cockpits: MFDS, HUD, MFK, HOTAS.

UNIT IV INTRODUCTION TO NAVIGATION SYSTEMS 9

Radio navigation – Dead – Reckoning systems, Hyperbolic Navigation - ILS, MLS – Inertial Navigation Systems (INS) – Inertial sensors, INS block diagram – Satellite navigation systems – GPS.

UNIT V AIR DATA SYSTEMS AND AUTO PILOT 9

Air data quantities – Altitude, Air speed, Vertical speed, Mach number, Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, Students will be able to

CO1: Develop a solid foundation in the theory, concepts and principles of fracture mechanics,

CO2: Be able to use these solutions to guide a corresponding design, manufacture, or failure analysis

CO3: Ability to investigate the life of a structure under dynamic loading conditions.

CO4: Knowledge of fracture mechanics approach applicable to homogeneous and heterogeneous materials

CO5: Knowledge of probalistic approach and development of mathematical models for life prediction of structures and knowledge of safe life and fail safe design.

TEXT BOOKS:

1. Albert Helfrick.D., Principles of Avionics, Avionics Communications Inc., 7th Edition, 2012.
2. Collinson.R.P.G. Introduction to Avionics, Chapman and Hall, 2003.

REFERENCES:

1. Middleton, D.H., Ed., Avionics systems, Longman Scientific and Technical, Longman Group UK Ltd., England, 1989.
2. Pallet.E.H.J., Aircraft Instruments and Integrated Systems, Longman Scientific,1992.
3. Spitzer, C.R. Digital Avionics Systems, Prentice-Hall, Englewood Cliffs, N.J.,U.S.A.1993.
4. Spitzer. C.R. The Avionics Hand Book, CRC Press, 2000.

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	PSO 1	PSO 2	PSO 3
CO.1	2	1	1	1			2					2			
CO.2	2	1	1	1			2					2			
CO.3	2	1	1	1			2					2			
CO.4	2	1	1	1			2					2			
CO.5	2	1	1	1			2					2			
CO	2	1	1	1			2					2			

PR5073	ROBOTIC TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the kinematics, drive systems and programming of robots.
- To study the basics of robot laws and transmission systems.
- To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
- To familiarize students with the various Programming and Machine Vision application in robots.
- To build confidence among students to evaluate, choose and incorporate robots in engineering systems.

UNIT I FUNDAMENTALS OF ROBOT **9**

Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications.

UNIT II ROBOT KINEMATICS **9**

Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg transformation.

UNIT III ROBOT DRIVE SYSTEMS AND END EFFECTORS **9**

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors,

Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, two fingered and three fingered grippers, internal grippers and external grippers, selection and design considerations of a gripper - gripper force calculation and analysis.

UNIT IV SENSORS IN ROBOTICS 9

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

UNIT V PROGRAMMING AND APPLICATIONS OF ROBOT 9

Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Interpret the features of robots and technology involved in the control.
2. Apply the basic engineering knowledge and laws for the design of robotics.
3. Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.
4. Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.
5. Demonstrate the image processing and image analysis techniques by machine vision system.

TEXT BOOKS:

1. Ganesh.S.Hedge ,"A textbook of Industrial Robotics", Lakshmi Publications, 2006. McGraw Hill 2th edition 2012.
2. Mikell.P.Groover , "Industrial Robotics – Technology, Programming and applications"

REFERENCES:

1. Fu K.S. Gonalz R.C. and ice C.S.G."Robotics Control, Sensing, Vision andIntelligence", McGraw Hill book co. 2007.
2. YoramKoren, "Robotics for Engineers", McGraw Hill Book, Co., 2002.
3. Janakiraman P.A., "Robotics and Image Processing", Tata McGraw Hill 2005.
4. John. J.Craig, "Introduction to Robotics: Mechanics and Control" 2nd Edition, 2002.
5. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer India reprint, 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	PSO 1	PSO 2	PSO 3
CO.1	1						2					2			2
CO.2	1						2					2			2
CO.3	1						2					2			2
CO.4	1						2					2			2
CO.5	1						2					2			2
CO	1						2					2			2

IT5351	DATABASE MANAGEMENT SYSTEMS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the fundamentals of data models, conceptualize and depict a database system using ER diagram.
- To study the principles to be followed to create an effective relational database and write SQL queries to store/retrieve data to/from database systems.
- To know the fundamental concepts of transaction processing, concurrency control techniques and recovery procedure.
- To learn about the internal storage structures using different file and indexing techniques and the basics of query processing and optimization.
- To study the basics of distributed databases, semi-structured and un-structured data models.

UNIT I RELATIONAL DATABASES 9

Purpose of Database System – Views of Data – Data Models – Database System Architecture – Introduction to Relational Databases – Relational Model – Keys – Relational Algebra – Relational Calculus – SQL Fundamentals – Advanced SQL features – Triggers – Embedded SQL.

Suggested Activities:

- Creating tables with key constraints, adding and removing constraints with referential integrity using DDL commands.
- Flipped classroom on relational algebra operations (selection, projection, joins etc.).
- Write SQL queries for demonstrating CRUD operations, aggregate functions and various join operations using DML commands.
- Create stored procedures for executing complex SQL transactions.□Create triggers for alerting user/system while manipulating data.

Suggested Evaluation Methods:

- Tutorials on DDL, DML and DCL queries.
- Quizzes on relational algebra operations.
- Demonstration of created stored procedures and triggers.

UNIT II DATABASE DESIGN 9

Entity-Relationship Model – ER Diagrams – Functional Dependencies – Non-Loss Decomposition Functional Dependencies – First Normal Form – Second Normal Form – Third Normal Form – Dependency Preservation – Boyce/Codd Normal Form – Multi-Valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

Suggested Activities:

- Simple database application design using ER diagram.
- Practical - ER modeling using open source tools and realizing database.
- Study of various anomalies and normalizing table (1NF, 2NF, 3NF, BCNF).
- Flipped classroom on topics of database design and normalization.

Suggested Evaluation Methods:

- Tutorials on application specific ER Diagram.
- Tutorials on normalization and database design.

UNIT III TRANSACTION MANAGEMENT 9

Transaction Concepts – ACID Properties – Serializability – Transaction Isolation Levels – Concurrency Control – Need for Concurrency – Lock-Based Protocols – Deadlock Handling – Recovery System – Failure Classification – Recovery Algorithm.

Suggested Activities:

- Checking serializability among transactions.
- Flipped classroom on concurrency control protocols.
- Study of crash recovery algorithm (ARIES).

Suggested Evaluation Methods:

- Tutorials on serializability and crash recovery algorithm
- Quizzes on concurrency control protocols.

UNIT IV IMPLEMENTATION TECHNIQUES 9

Overview of Physical Storage Media – RAID – File Organization – Organization of Records in Files – Indexing and Hashing – Ordered Indices – B+ tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Catalog Information for Cost Estimation – Query Optimization.

Suggested Student Activities:
- Study of different RAID levels and its uses in different applications.
- Practical - Creation of B+ tree with insertion and deletion operations.
- Assignments on cost estimation of different types of queries.

Suggested Evaluation Methods:
- Report on applications of RAID levels.
- Tutorials on B+ Tree manipulation.
- Quizzes on hashing mechanisms.
- Exercise on cost estimation for various SQL queries.
- Evaluation of the practical assignments.

UNIT V ADVANCED TOPICS 9

Overview of Distributed Databases – Data Fragmentation – Replication – XML Databases – XML Schema – NOSQL Database: Characteristics – CAP theorem – Types of NoSQL Datastores: Column Oriented, Document, Key-Value and Graph Types – Applications – Current Trends.

Suggested Student Activities:
- Design of distributed database using fragmentation.
- Creation of XML document based on XML schema.
- Creation of document and column oriented databases and simple manipulation.

Suggested Evaluation Methods:
- Tutorials on fragmenting database tables and writing simple SQL queries.
- Assignments on creation of XML schema and validating XML documents.
- Demonstration of created document and column-oriented databases.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, the student will be able to:
1. Model an application's data requirements using conceptual modeling and design database schemas based on the conceptual model.
2. Formulate solutions to a broad range of query problems using relational algebra/SQL.
3. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
4. Run transactions and estimate the procedures for controlling the consequences of concurrent data access.
5. Explain basic database storage structures, access techniques and query processing.
6. Describe distributed, semi-structured and unstructured database systems.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2014.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2017.

REFERENCES:

1. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
2. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", Fourth Edition, Tata McGraw Hill, 2010.
3. G. K. Gupta, "Database Management Systems", Tata McGraw Hill, 2011.
4. Carlos Coronel, Steven Morris, Peter Rob, "Database Systems: Design, Implementation and Management", Ninth Edition, Cengage Learning, 2011.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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CO.3	2	1	1	1	1	2	2	1	1	1	1	2	1		
CO.4	2	1	1	1	1		2	1	1		1	2	1		
CO.5	2	1	1	1	1	2	2	1	1		1	2	1		
CO.6	2	1	1	1	1	2	2	1	1	1	1	2	1		
CO	2	1	1	1	1	2	2	1	1	1	1	2	1		

IT5551	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of layering in networks.
- To know the functions of protocols of each layer of TCP/IP protocol suite.
- To visualize the end-to-end flow of information.
- To understand the components required to build different types of networks.
- To learn concepts related to network addressing and routing.

UNIT I INTRODUCTION AND APPLICATION LAYER 9

Building network – Network Edge and Core – Layered Architecture – OSI Model – Internet Architecture (TCP/IP) Networking Devices: Hubs, Bridges, Switches, Routers, and Gateways – Performance Metrics – Introduction to Sockets – Application Layer protocols – HTTP – FTP Email Protocols – DNS.

Suggested Activities:

- In-class activity - Solving problems on performance metrics.
- In-class activity - HTTP problems.
- Accessing HTTP and SMTP server through Telnet.
- External learning - HTTP/DNS format using a tool like Wireshark.
- External learning - POP3 and IMAP protocols of email application.

Suggested Evaluation Methods:

- Quiz on Wireshark.
- Quiz on POP3 and IMAP.
- Assignment problems different protocols.

UNIT II TRANSPORT LAYER 9

Transport Layer functions – Multiplexing and Demultiplexing – User Datagram Protocol – UDP Applications – Transmission Control Protocol – Flow Control – Retransmission Strategies – Congestion Control.

Suggested Activities:

- Flipped Classroom on UDP Applications.
- External learning - Wireshark for UDP, TCP packet formats.
- External learning - Transport for Real Time Applications.

- External learning - Understanding RFCs.
- Assignments on flow control analysis in class.

Suggested Evaluation Methods:
- Quiz on UDP applications.
- Quiz on real time transport protocols.
- Discussion/assignment on RFC.
- Interpreting Wireshark output.

UNIT III NETWORK LAYER 9

Network Layer: Switching concepts – Internet Protocol – IPV4 Packet Format – IP Addressing – Subnetting – Classless Inter Domain Routing (CIDR) – Variable Length Subnet Mask (VLSM) – DHCP – ARP – Network Address Translation (NAT) – ICMP – Concept of SDN.

Suggested Activities:
- In-class activity - IP addressing.
- External learning - IPV4 Packet Format using Wireshark.
- In-class activity - Subnetting for different scenarios.
- Flipped classroom on CIDR.
- External learning - Ping and trace-route commands.
- Mini-project on the implementation of a protocol based on an RFC.

Suggested Evaluation Methods:
- Quiz on CIDR.
- Check ability to use commands.

UNIT IV ROUTING 7

Routing Principles – Distance Vector Routing – Link State Routing – RIP – OSPF – BGP – IPV6 – Introduction to Quality of Service (QoS).

Suggested Activities:
- In-class activity - Distance Vector Routing, Link State Routing.
- External learning - RIP, OSPF packet formats.
- Assignment on Link state routing for different network graphs.
- In-class activity - Error Detection and Correction.
- Flipped classroom on IPV6.
- External learning - Study on global IP address assignment.

Suggested Evaluation Methods:
- Quizzes on RIP, OSPF packet format.
- Quiz on IPv6.

UNIT V DATA LINK AND PHYSICAL LAYERS 11

Data Link Layer – Framing – Flow control – Error control – Media Access Control – Ethernet Basics – CSMA/CD – Virtual LAN – Wireless LAN (802.11) – Physical layer – Signals – Bandwidth and Data Rate – Encoding – Multiplexing – Shift Keying – Transmission Media.

Suggested Activities:
- In-class activity - Problems on encoding techniques.
- External learning - Virtual LAN , Wireless LAN (802.11) formats.
- Flipped Classroom on recent developments in transmission media.
- Design a protocol for some application.
- Trace the end-to-end flow of packets through the network.

Suggested Evaluation Methods:
- Quizzes on VLAN and 802.11 formats.
- Presentation/Implementation of design.
- Demonstration of RFC implementation project.

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Highlight the significance of the functions of each layer in the network.
2. Identify the devices and protocols to design a network and implement it.
3. Build network applications using the right set of protocols and estimate their performances.
4. Trace packet flows and interpret packet formats.
5. Apply addressing principles such as subnetting and VLSM for efficient routing.
6. Explain media access and communication techniques.

TEXT BOOKS:

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", Seventh Edition, Pearson Education, 2017.
2. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.

REFERENCES:

1. William Stallings, "Data and Computer Communications", Tenth Edition, Pearson Education, 2014.
2. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill, 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	PSO 1	PSO 2	PSO 3
CO.1	1	1	1										1		
CO.2	1	1	1										1		
CO.3	1	1	1	1					1			1	1		
CO.4	1	1	1	1									1		
CO.5	1	1	1	1									1		
CO.6	1	1	1	1									1		
CO	1	1	1	1					1			1	1		

IT5451	COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To identify the functional units in a digital computer system.
- To distinguish between the various ISA styles.
- To trace the execution sequence of an instruction through the processor.
- To evaluate different computer systems based on performance metrics.
- To understand the fundamentals of memory and I/O systems and their interface with the processor.

UNIT I FUNDAMENTALS OF COMPUTER SYSTEMS 9

Functional Units of a Digital Computer – Operation and Operands of Computer Hardware – Software Interface – Translation from a High Level Language to Machine Language – Instruction Set Architecture – RISC and CISC Architectures – Addressing Modes –Performance Metrics – Power Law – Amdahl's Law.

Suggested Activities:

- In-class activity on performance evaluation.
- Flipped classroom – Evolution and types of computer systems, identification of benchmarks.
- Use a Simulator for RISC and CISC. Analyze the ISA supported by the architectural simulator by running simple programs on the simulator.
- Mapping and correlating a C code with its machine code.
- Practical – Opening up a computer system and studying the components.

Suggested Evaluation Methods:

- Mock test on problems for computer performance.
- Group discussion on activity four with assembly instruction, identifying the instruction type and encoding used in machine code.
- Quizzes on ISA.

UNIT II ARITHMETIC FOR COMPUTERS 9

Addition and Subtraction – Fast Adders – Multiplication: Booths Algorithm, Bit Pair Recoding – Division: Restoring and Non-Restoring – Floating Point Numbers: Single and Double Precision – Arithmetic Operations – ALU Design. Suggested Activities:

- Flipped classroom – Unsigned binary operations(+,–,*,/).
- Simulation of the floating point operations.
- External learning – Arithmetic algorithms for faster multiplication and division.
- Tutorials on multiplication and division (Booths algorithm, restoring and non-restoring).

Suggested Evaluation Methods:

- Mock test on multiplication and division.
- Quizzes on floating point single precision and double precision representation.

UNIT III PROCESSOR 9

Design Convention of a Processor – Building a Datapath and designing a Control Unit – Execution of a Complete Instruction – Hardwired and Micro programmed Control –Instruction Level Parallelism – Basic Concepts of Pipelining – Pipelined Implementation of Datapath and Control Unit – Hazards – Structural, Data and Control Hazards.

Suggested Activities:

- Flipped Classroom for analyzing data path in Intel and ARM core.
- Practical – Analyzing the data path on the standard simulator.
- Practical – Study of the pipelined implementation and analysis of various hazards on a standard simulator.

Suggested Evaluation Methods:

- Assignment on data path design.
- Group discussion on pipeline depth and stages.
- Quiz on class or automatic quizzes on the flipped classroom content.

UNIT IV MEMORY AND I/O 9

Types of Memories – Need for a hierarchical memory system – Cache memories– Memory Mapping – Improving Cache Performance – Virtual Memory – Memory Management Techniques – Accessing I/O devices – Programmed Input/output – Interrupts – Direct Memory Access.

Suggested Activities:

- Flipped classroom on memory hierarchy in Intel i7 and ARM Cortex.
- Practical – Implement a simple functional model for memory mapping in cache using C/C++.
- Study hit/miss rates for various access patterns. Experiment with different replacement policies.

Suggested Evaluation Methods:

- Mock test for problems on memory mapping.
- Quizzes on memory management in ARM and Intel processor.

UNIT V PARALLEL PROCESSING 9

Exploitation of more ILP – Dynamic Scheduling: Tomasulo's Algorithm – Introduction to Multicore – Graphics Processing Units – Overview of Next Generation Processors.

Suggested Activities:

- Flipped classroom on evolution of GPU.
- External learning – Speculative dynamic scheduling.
- Survey on multicore and draw a mind map on trends of multicore processors.

Suggested Evaluation Methods:

- Quizzes on dynamic scheduling.

- Group discussion on how to reduce CPI to less than one clock cycle.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Interpret assembly language instructions.
- Design and analyze ALU circuits.
- Implement a control unit as per the functional specification.
- Design and analyze memory, I/O devices and cache structures for processor.
- Evaluate the performance of computer systems.
- Point out the hazards present in a pipeline and suggest remedies.

TEXT BOOKS:

1. David A. Patterson, John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Fifth Edition, Morgan Kaufmann/Elsevier, 2013.
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, "Computer Organization and Embedded Systems", Sixth Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. William Stallings, "Computer Organization and Architecture – Designing for Performance", Tenth Edition, Pearson Education, 2016.
2. John L. Hennessey, David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann / Elsevier Publishers, Fourth Edition, 2007.
3. V.P. Heuring, H.F. Jordan, "Computer Systems Design and Architecture", Second Edition, Pearson Education, 2004. 6. Behrooz Parhami, "Computer Architecture", Oxford University Press, 2007.
4. Douglas E. Comer, "Essentials of Computer Architecture", Sixth Edition, Pearson Education, 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	PSO 1	PSO 2	PSO 3
CO.1	2	1	1	1								2	1		
CO.2	2	1	1	1							1	2	1		
CO.3	2	1	1	1							1	2	1		
CO.4	2	1	1	1							1	2	1		
CO.5	2	1	1	1							1	2	1		
CO.6	2	1	1	1							1	2	1		
CO	2	1	1	1							1	2	1		

IT5352	PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I C PROGRAMMING FUNDAMENTALS **9**

Data Types – Variables – Operations – Expressions and Statements – Conditional Statements – Functions – Recursive Functions – Arrays – Single and Multi-Dimensional Arrays.

Suggested Activities:

- Implementing programs using data types, arithmetic operators and basic input/output operations.

- Developing programs using if-else, do-while, while, for, switch, break, continue, enum.
- Write an application to perform operations like finding the maximum, minimum, average values using single dimensional integer and float arrays.
- Develop an application to perform matrix operations using multi-dimensional arrays.
- Create an application that performs operations like concatenation, finding a substring from a given string, etc. using character arrays.
- Develop any application (student's choice) using User-defined functions and Recursive functions.

Suggested Evaluation Methods:

- Tutorials on conditionals and loops.
- Evaluation of the programs implemented.

UNIT II C PROGRAMMING - ADVANCED FEATURES 9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions – File Handling – Preprocessor Directives.

Suggested Activities:

- Implementing applications using Structures, Unions, Enumerations.
- Demonstration of C programs using pointers to variables, arrays, functions and using address arithmetic.
- Demonstration of programs using dynamic memory.
- Demonstration of real world applications using file operations.

Suggested Evaluation Methods:

- Tutorials on file handling.
- Checking output of programs implemented.

UNIT III LINEAR DATA STRUCTURES 9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – DoublyLinked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

Suggested Activities:

- Converting an algorithm from recursive to non-recursive using stack.
- Demonstrating stack for Towers of Hanoi application.
- Developing any application (student's choice) using all the linear data structures.

Suggested Evaluation Methods:

- Tutorials on applications of linear data structures.
- Checking output of programs implemented.

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing - Hash Functions – Separate Chaining – Open Addressing – Linear Probing– Quadratic Probing – Double Hashing – Rehashing.

Suggested Activities:

- Implementing binary tree and tree traversals.
- Solving expressions using expression trees by determining infix, prefix and postfix expressions.
- Implementation of phone directory using hash tables.
- Developing any application using trees.

Suggested Evaluation Methods:

- Tutorials on hashing.
- Check output of programs implemented.
- Quiz on various topics of the unit.

UNIT V SORTING AND SEARCHING TECHNIQUES 9

Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

Suggested Activities:

- External learning - External sorting implementation.
- Implementation of all sorting techniques in C language.
- Demonstration of searching techniques under best- and worst-case inputs.

Suggested Evaluation Methods:

- Tutorials on external sorting.
- Checking output of programs implemented.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Develop C programs for any real world/technical application.
2. Apply advanced features of C in solving problems.
3. Write functions to implement linear and non–linear data structure operations.
4. Suggest and use appropriate linear/non–linear data structure operations for solving a givenproblem.
5. Appropriately use sort and search algorithms for a given application.
6. Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.
2. Reema Thareja, "Programming in C", Second Edition, Oxford University Press, 2016.

REFERENCES:

1. Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, "C How to Program", Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education,1983.
4. Ellis Horowitz, Sartaj Sahni and Susan Anderson, "Fundamentals of Data Structures", Galgotia, 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	PSO 1	PSO 2	PSO 3
CO.1	2	1	1	1		2			1			2	1		
CO.2	2	1	1	1		2			1			2	1		
CO.3	2	1	1	1		2			1			2	1		
CO.4	2	1	1	1		2			1			2	1		
CO.5	2	1	1	1		2			1			2	1		
CO.6	2	1	1	1		2			1			2	1		
CO	2	1	1	1		2			1			2	1		

AUDIT COURSES

AD5091	CONSTITUTION OF INDIA	L	T	P	C
		3	0	0	0

OBJECTIVES:

- Teach history and philosophy of Indian Constitution.
- Describe the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Summarize powers and functions of Indian government.
- Explain emergency rule.
- Explain structure and functions of local administration.

UNIT I INTRODUCTION **9**

History of Making of the Indian Constitution-Drafting Committee- (Composition & Working) Philosophy of the Indian Constitution-Preamble-Salient Features

UNIT II CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES **9**

Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies Directive Principles of State

Policy-Fundamental Duties

UNIT III ORGANS OF GOVERNANCE **9**

Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions

UNIT IV EMERGENCY PROVISIONS **9**

Emergency Provisions - National Emergency, President Rule, Financial Emergency

UNIT V LOCAL ADMINISTRATION **9**

District's Administration head- Role and Importance-Municipalities- Introduction- Mayor and role of Elected Representative-CEO of Municipal Corporation-Pachayati raj- Introduction- PRI- Zila Pachayat-Elected officials and their roles- CEO ZilaPachayat- Position and role-Block levelOrganizational Hierarchy (Different departments)-Village level- Role of Elected and Appointed officials-Importance of grass root democracy

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Able to understand history and philosophy of Indian Constitution.
2. Able to understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
3. Able to understand powers and functions of Indian government.
4. Able to understand emergency rule.
5. Able to understand structure and functions of local administration.

TEXT BOOKS:

1. Basu D D, Introduction to the Constitution of India, Lexis Nexis, 2015.
2. Busi S N, Ambedkar B R framing of Indian Constitution, 1st Edition, 2015.
3. Jain M P, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. The Constitution of India (Bare Act), Government Publication,1950

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	PSO 1	PSO 2	PSO 3
CO020.1							3	3	3	3	3	3			1
CO020.2							3	3	3	3	3	3			1
CO020.3							3	3	3	3	3	3			1
CO020.4							3	3	3	3	3	3			1
CO020.5							3	3	3	3	3	3			1
CO020							3	3	3	3	3	3			1

AD5092	VALUE EDUCATION	L	T	P	C
		3	0	0	0

OBJECTIVES:

- Develop knowledge of self-development
- Explain the importance of Human values
- Develop the overall personality through value education
- Overcome the self-destructive habits with value education
- Interpret social empowerment with value education

UNIT I INTRODUCTION TO VALUE EDUCATION **9**

Values and self-development –Social values and individual attitudes, Work ethics, Indian vision of humanism, Moral and non- moral valuation, Standards and principles, Value judgements

UNIT II IMPORTANCE OF VALUES 9

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance, Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity, Power of faith, National Unity, Patriotism, Love for nature, Discipline

UNIT III INFLUENCE OF VALUE EDUCATION 9

Personality and Behaviour development - Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth.

UNIT IV REINCARNATION THROUGH VALUE EDUCATION 9

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation

UNIT V VALUE EDUCATION IN SOCIAL EMPOWERMENT 9

Equality, Nonviolence, Humility, Role of Women, All religions and same message,Mind your Mind, Self-control, Honesty, Studying effectively

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Gain knowledge of self-development
2. Learn the importance of Human values
3. Develop the overall personality through value education
4. Overcome the self destructive habits with value education
5. Interpret social empowerment with value education

REFERENCES:

1. Chakroborty , S.K. “Values and Ethics for organizations Theory and practice”, Oxford UniversityPress 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	PSO 1	PSO 2	PSO 3
CO.1							3	3	3	3	3	3			1
CO.2							3	3	3	3	3	3			1
CO.3							3	3	3	3	3	3			1
CO.4							3	3	3	3	3	3			1
CO.5							3	3	3	3	3	3			1
CO.6							3	3	3	3	3	3			1
CO							3	3	3	3	3	3			1

AD5093	PEDAGOGY STUDIES	L	T	P	C
		3	0	0	0

OBJECTIVES:

- Understand the methodology of pedagogy.
- Compare pedagogical practices used by teachers in formal and informal classrooms in developing countries.
- Infer how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
- Illustrate the factors necessary for professional development.

UNIT I INTRODUCTION AND METHODOLOGY: 9

Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.

UNIT II THEMATIC OVERVIEW 9

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES 9

Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT 9

Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS 9

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Understand the methodology of pedagogy.
2. Understand Pedagogical practices used by teachers in formal and informal classrooms in developing countries.
3. Find how can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.
4. Know the factors necessary for professional development.
5. Identify the Research gaps in pedagogy.

REFERENCES:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

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	PSO 1	PSO 2	PSO 3
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CO.2						3	3	3	3	3	3	3			1
CO.3						3	3	3	3	3	3	3			1
CO.4						3	3	3	3	3	3	3			1
CO.5						3	3	3	3	3	3	3			1
CO						3	3	3	3	3	3	3			1

AD5094	STRESS MANAGEMENT BY YOGA	L	T	P	C
		3	0	0	0

OBJECTIVES:

- Develop healthy mind in a healthy body thus improving social health also improve efficiency
- Invent Do's and Don't's in life through Yam
- Categorize Do's and Don't's in life through Niyam
- Develop a healthy mind and body through YogAsans
- Invent breathing techniques through Pranayam

UNIT I INTRODUCTION TO YOGA **9**

Definitions of Eight parts of yog. (Ashtanga)

UNIT II YAM **9**

Do`s and Don't's in life.
Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

UNIT III NIYAM **9**

Do`s and Don't's in life.
Ahinsa, satya, astheya, bramhacharya and aparigraha

UNIT IV ASAN **9**

Various yog poses and their benefits for mind & body

UNIT V PRANAYAM **9**

Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Develop healthy mind in a healthy body thus improving social health also improve efficiency
2. Learn Do's and Don't's in life through Yam
3. Learn Do's and Don't's in life through Niyam
4. Develop a healthy mind and body through YogAsans
5. Learn breathing techniques through Pranayam

REFERENCES:

1. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
2. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur

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	PSO 1	PSO 2	PSO 3
CO.1							3	3	3	3	3	3			1
CO.2							3	3	3	3	3	3			1
CO.3							3	3	3	3	3	3			1
CO.4							3	3	3	3	3	3			1
CO.5							3	3	3	3	3	3			1
CO							3	3	3	3	3	3			1

AD5095	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		3	0	0	0

OBJECTIVES:

- Develop basic personality skills holistically
- Develop deep personality skills holistically to achieve happy goals
- Rewrite the responsibilities
- Reframe a person with stable mind, pleasing personality and determination
- Discover wisdom in students

UNIT I NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - I **9**

Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue)

UNIT II NEETISATAKAM-HOLISTIC DEVELOPMENT OF PERSONALITY - II **9**

Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's)

UNIT III APPROACH TO DAY TO DAY WORK AND DUTIES **9**

Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48

UNIT IV STATEMENTS OF BASIC KNOWLEDGE – I **9**

Statements of basic knowledge - Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18

UNIT V PERSONALITY OF ROLE MODEL - SHRIMAD BHAGWADGEETA **9**

Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 45 PERIODS

OUTCOMES:

1. To develop basic personality skills holistically
2. To develop deep personality skills holistically to achieve happy goals
3. To rewrite the responsibilities
4. To reframe a person with stable mind, pleasing personality and determination
5. To awaken wisdom in students

REFERENCES:

1. Gopinath,Rashtriya Sanskrit Sansthanam P, Bhartrihari'sThreeSatakam , Niti-sringarvairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, AdvaitaAshram,Publication Department, Kolkata,2016.

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	PSO 1	PSO 2	PSO 3
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CO.2							3	3	3	3	3	3			1
CO.3							3	3	3	3	3	3			1
CO.4							3	3	3	3	3	3			1
CO.5							3	3	3	3	3	3			1
CO							3	3	3	3	3	3			1

AD5097	ESSENCE OF INDIAN KNOWLEDGE TRADITION	L	T	P	C
		3	0	0	0

COURSE OBJECTIVES

The course will introduce the students to

- get a knowledge about Indian Culture
- Know Indian Languages and Literature religion and philosophy and the fine arts in India
- Explore the Science and Scientists of Ancient, Medieval and Modern India Understand education systems in India

UNIT I INTRODUCTION TO CULTURE 9

Culture, civilization, culture and heritage, general characteristics of culture, importance of culture in human literature, Indian Culture, Ancient India, Medieval India, Modern India.

UNIT II INDIAN LANGUAGES AND LITERATURE 9

Indian Languages and Literature – I: Languages and Literature of South India, – Indian Languages and Literature – II: Northern Indian Languages & Literature

UNIT III RELIGION AND PHILOSOPHY 9

Major religions practiced in India and Understanding their Philosophy – religious movements in Modern India (Selected movements only)

UNIT IV FINE ARTS IN INDIA (ART, TECHNOLOGY& ENGINEERING) 9

Indian Painting, Indian handicrafts, Music, divisions of Indian classic music, modern Indian music, Dance and Drama, Indian Architecture (ancient, medieval and modern), Science and Technology in India, development of science in ancient, medieval and modern India

UNIT V EDUCATION SYSTEM IN INDIA 9

Education in ancient, medieval and modern India, aims of education, subjects, languages, Science and Scientists of Ancient India, Science and Scientists of Medieval India, Scientists of Modern India

TOTAL: 45 PERIODS

COURSE OUTCOMES

After successful completion of the course the students will be able to Understand philosophy of Indian culture.

1. Distinguish the Indian languages and literature.
2. Distinguish the Indian languages and literature.
3. Learn the philosophy of ancient, medieval and modern India.
4. Acquire the information about the fine arts in India.
5. Know the contribution of scientists of different eras.
6. Understand education systems in India

REFERENCES:

1. Kapil Kapoor, “Text and Interpretation: The India Tradition”,ISBN: 81246033375, 2005
2. “Science in Samskrit”, Samskrita Bharti Publisher, ISBN 13: 978-8187276333, 2007
3. NCERT, “Position paper on Arts, Music, Dance and Theatre”, ISBN 81-7450 494-X, 200
4. Narain, “Examinations in ancient India”, Arya Book Depot, 1993
5. Satya Prakash, “Founders of Sciences in Ancient India”, Vijay Kumar Publisher, 1989
6. M. Hiriyanna, “Essentials of Indian Philosophy”, Motilal Banarsidass Publishers, ISBN 13: 978-8120810990, 2014

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	PSO 1	PSO 2	PSO 3
CO.1							3	3	3	3	3	3			1
CO.2							3	3	3	3	3	3			1
CO.3							3	3	3	3	3	3			1
CO.4							3	3	3	3	3	3			1
CO.5							3	3	3	3	3	3			1
CO.6							3	3	3	3	3	3			1
CO							3	3	3	3	3	3			1

AD5098	SANGA TAMIL LITERATURE APPRECIATION	L	T	P	C
		3	0	0	0

Course Objectives:

The main learning objective of this course is to make the students an appreciation for:

- Introduction to Sanga Tamil Literature.
- 'Agathinai' and'Purathinai' in Sanga Tamil Literature.
- 'Attruppadai' in SangaTamil Literature.
- 'Puranaanuru' in SangaTamil Literature.
- 'Pathitrupaththu' in SangaTamil Literature.

UNIT I SANGA TAMIL LITERATUREANINTRODUCTION 9

Introduction to Tamil Sangam–History of Tamil Three Sangams–Introduction to Tamil Sangam Literature–Special Branches in Tamil Sangam Literature- Tamil Sangam Literature's Grammar- Tamil Sangam Literature's parables.

UNIT II 'AGATHINAI'AND'PURATHINAI' 9

Tholkappiyar's Meaningful Verses–Three literature materials–Agathinai's message- History of Culturefrom Agathinai – Purathinai – Classification– Mesaage to Society from Purathinai.

UNIT III 'ATTRUPPADAI'. 9

Attruppadai Literature – Attruppadaiin 'Puranaanuru' – Attruppadaiin 'Pathitrupaththu' - Attruppadai in 'Paththupaattu'.

UNIT IV 'PURANAANURU' 9

Puranaanuru onGood Administration,Rulerand Subjects–Emotion&itsEffectin Puranaanuru.

UNIT V 'PATHITRUPATHTHU' 9

Pathitrupaththuin'Ettuthogai'–Pathitrupaththu'sParables–Tamildynasty:Valor,Administration, Charity in Pathitrupaththu- Mesaage to Society from Pathitrupaththu.

Total (L:45) = 45 PERIODS

COURSE OUTCOMES:

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

1. Appreciate and apply the messages in Sanga Tamil Literature in their life.
2. Differentiate 'Agathinai' and 'Purathinai' in their personal and societal life.
3. Appreciate and apply the messages in 'Attruppadai' in their personal and societa life.
4. Appreciate and apply the messages in 'Puranaanuru' in their personal and societal life.
5. Appreciate and apply the messages in 'Pathitrupaththu' in their personal and societal life.

REFERENCES:

1. Sivaraja Pillai, The Chronology oftheEarlyTamils,SagwanPress,2018.
2. Hank Heifetz and George L. Hart, The Purananuru, Penguin Books,2002.
3. Kamil Zvelebil, The Smile of Murugan: On Tamil Literature of South India, Brill Academic Pub,1997.
4. George L. Hart, Poets of the Tamil Anthologies: Ancient Poems of Love and War, Princeton University Press,2015.
5. Xavier S. Thani Nayagam, Landscape and poetry: a study of nature in classical Tamil poetry, Asia Pub. House, 1967.

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	PSO 1	PSO 2	PSO 3
CO.1							3	3	3	3	3	3			1
CO.2							3	3	3	3	3	3			1
CO.3							3	3	3	3	3	3			1
CO.4							3	3	3	3	3	3			1
CO.5							3	3	3	3	3	3			1
CO							3	3	3	3	3	3			1

HSMC– ELECTIVES – HUMANITIES I (ODD SEMESTER)

HU5171	LANGUAGE AND COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE DESCRIPTION

This course offers an introduction to language and communication. The primary goal of this course is to familiarize students with key ideas related to communication using language as well as non verbal means. Ideas related to the use of language and the underlying power structures are also examined. The course also examines the role of media in communication and in the dissemination of ideas as well as opinions.

Objectives

- To familiarize students with the concept of communication using linguistic and non linguistic resources.
- To help students ask critical questions regarding facts and opinions.
- To provide students with the material to discuss issues such as language and power structures.
- To help students think critically about false propaganda and fake news.
- Learning Outcomes
- Students will be able to use linguistic and non linguistic resources of language in an integrated manner for communication.
- Students will be able to analyse communication in terms of facts and opinions.
- Students will be able to discuss, analyse and argue about issues related to language and power.

UNIT I LINGUISTIC AND NON-LINGUISTIC RESOURCE OF COMMUNICATION: 9

a) Writing and Speech
b) Distinction between language structure and language use, form and function, acceptability and grammaticality
c) Gestures and Body language, pictures and symbols, cultural appropriacy
d) Communicative Competency, context and situation, combination of linguistic and non-linguistic elements of communication

UNIT II STRUCTURE OF WRITING/CONVERSATION: 9

a) Language skills and the communication cycle; speaking and listening, writing and reading
b) Initiating and closing conversations, intervention, turn taking
c) Writing for target reader, rhetorical devices and strategies

d) Coherence and Cohesion in speech and writing

UNIT III POWER STRUCTURE AND LANGUAGE USE: 9

a) Gender and language use
b) Politeness expressions and their use
c) Ethical dimensions of language use
d) Language rights as part of human rights

UNIT IV MEDIA COMMUNICATION: 9

a) Print media, electronic media, social media
b) Power of media
c) Manufacturing of opinion, fake news and hidden agendas

UNIT V PERSUASIVE COMMUNICATION AND MISCOMMUNICATION: 9

a) Fundamentals of persuasive communication
b) Persuasive strategies
c) Communication barriers

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Austin, 1962, J.L. How to do things with words. Oxford: Clarendon Press. Grice, P.1989. Studies in the way of words. Cambridge, M.A: Harvard University Press.
2. Chomsky, N.1966. Aspects of the theory of syntax, The MIT press, Cambridge. Chomsky, N.2006. Language and Mind, Cambridge University Press.
3. Hymes. D.N. 1972, On communication competence in J.B. Pride and J.Holmes (ed), Sociolinguistics, pp 269-293, London Penguin.
4. Gilbert, H.Harman, 1976. Psychological aspect of the theory of syntax in Journal of Philosophy, page 75-87.
5. Stephen. C. Levenson, 1983, Pragmatics, Cambridge University press.
6. Stangley, J. 2007. Language in Context. Clarendon press, Oxford. 7. Shannon, 1942. A Mathematical Theory of Communication. 8. Searle, J.R. 1969. Speech acts: An essay in the philosophy of language. Cambridge: Cambridge 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	PSO 1	PSO 2	PSO 3
CO.1							3	3	3	3	3	3			1
CO.2							3	3	3	3	3	3			1
CO.3							3	3	3	3	3	3			1
CO.4							3	3	3	3	3	3			1
CO							3	3	3	3	3	3			1

HU5172	VALUES AND ETHICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Teach definition and classification of values.
- Explain Purusartha.
- Describe Sarvodaya idea.
- Summarize sustenance of life.
- Conclude views of hierarchy of values.

UNIT I DEFINITION AND CLASSIFICATION OF VALUES 9

Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- EconomicSocial-Aesthetic-Moral and Religious values

UNIT II CONCEPTS RELATED TO VALUES 9

Purusartha-Virtue- Right- duty- justice- Equality- Love and Good

UNIT III IDEOLOGY OF SARVODAYA 9

Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV SUSTENANCE OF LIFE 9

The Problem of Sustenance of value in the process of Social, Political and Technological Changes

UNIT V VIEWS ON HIERARCHY OF VALUES 9

The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi

TOTAL: 45 PERIODS

OUTCOMES:

1. Able to understand definition and classification of values.
2. Able to understand purusartha.
3. Able to understand sarvodaya idea.
4. Able to understand sustenance of life.
5. Able to understand views of hierarchy of values.

TEXT BOOKS:

1. AwadeshPradhan :MahamanakeVichara. (B.H.U., Vanarasi-2007)
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)
3. William, K Frankena : Ethics (Prentice Hall of India, 1988)

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	PSO 1	PSO 2	PSO 3
CO.1						3	3	3	3	3	3	3			1
CO.2						3	3	3	3	3	3	3			1
CO.3						3	3	3	3	3	3	3			1
CO.4						3	3	3	3	3	3	3			1
CO.5						3	3	3	3	3	3	3			1
CO						3	3	3	3	3	3	3			1

HU5173	HUMAN RELATIONS AT WORK	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Illustrate human relations at work its relationship with self.
- Explain the importance of interacting with people at work to develop teamwork.
- Infer the importance of physical health in maintaining human relations at work.
- Describe the importance of staying psychologically healthy.
- Identify the essential qualities for progressing in career.

UNIT I UNDERSTANDING AND MANAGING YOURSELF 9

Human Relations and You: Self-Esteem and Self-Confidence: Self-Motivation and Goal Setting; Emotional Intelligence, Attitudes, and Happiness; Values and Ethics and Problem Solving and Creativity.

UNIT II DEALING EFFECTIVELY WITH PEOPLE 9

Communication in the Workplace; Specialized Tactics for Getting Along with Others in the Workplace; Managing Conflict; Becoming an Effective Leader; Motivating Others and Developing Teamwork; Diversity and Cross-Cultural Competence.

UNIT III STAYING PHYSICALLY HEALTHY 9

Yoga, Pranayam and Exercise: Aerobic and anaerobic.

UNIT IV STAYING PSYCHOLOGICALLY HEALTHY 9

Managing Stress and Personal Problems, Meditation.

UNIT V DEVELOPING CAREER THRUST 9

Getting Ahead in Your Career, Learning Strategies, Perception, Life Span Changes, and Developing Good Work Habits.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to

1. Understand the importance of self-management.
2. Know how to deal with people to develop teamwork.
3. Know the importance of staying healthy.
4. Know how to manage stress and personal problems.
5. Develop the personal qualities essential for career growth.

TEXT BOOK:

1. Dubrien, A. J. (2017). Human Relations for Career and Personal Success: Concepts, Applications, and Skills, 11th Ed. Upper Saddle River, NJ: Pearson.

REFERENCES:

1. Greenberg, J. S. (2017). Comprehensive stress management (14th edition), New York: McGrawHill.
2. Udai, Y. (2015). Yogasanaurpranayam. New Delhi: N.S. Publications.

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	PSO 1	PSO 2	PSO 3
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CO.3						3	3	3	3	3	3	3			1
CO.4						3	3	3	3	3	3	3			1
CO.5						3	3	3	3	3	3	3			1
CO.6						3	3	3	3	3	3	3			1
CO						3	3	3	3	3	3	3			1

HU5174	PSYCHOLOGICAL PROCESSES	L	T	P	C
		3	0	0	3

COURSE DESCRIPTION

Psychological Processes course is designed for students to be aware of the basic principles of psychology for the better understanding of people's psyche and behaviour around them. This course enables learners to use the optimal use of different forms of thinking skills and thereby results in effective communication in diverse situations. Every unit of the syllabus highlights the psychological process of people, the most powerful and constructive use of perceptions.

OBJECTIVES

The major objectives of this course is

- To develop students' awareness – on psychology, learning behavior and usage of perception effectively.
- To learn to use the various kinds of thinking in a formal context.
- To critically evaluate content and comprehend the message on the bases of perception, personality and intelligence.

UNIT 1: INTRODUCTION **9**

What is psychology? - Why study psychology? - Psychology as science – Behavior and its role in human communication – socio-cultural bases of behaviour – Biological bases of behavior - Brain and its functions – Principles of Heredity – Cognition and its functions Fields of psychology – Cognitve and Perceptual – Industrial and Organizational.

UNIT 2: SENSORY & PERCEPTUAL PROCESSES **9**

Some general properties of Senses: Visual system – the eye, colour vision – Auditory system – Hearing, listening, Sounds - Other senses - Selective attention; physiological correlates of attention; Internal influences on perception learning – set - motivation & emotion - cognitive styles; External influences on perception figure and ground separation – movement – organization – illusion; Internal- external interactions: Constancy - Depth Perception- Binocular & Monocular Perception; Perceptual defense & Perceptual vigilance; Sensory deprivation -Sensory bombardment; ESP - Social Perception.

UNIT 3: COGNITION & AFFECT **9**

Learning and memory – philosophy of mind – concepts - words – images – semantic features – Association of words – Repetition – Retrieval – Chunking - Schemata - Emotion and motivation – nature and types of motivation – Biological & Psychosocial motivation – nature and types of emotions – physiological & cognitive bases of emotions – expressions of emotions – managing negative emotions - enhancing positive emotions.

UNIT 4: THINKING, PROBLEM-SOLVING & DECISION MAKING **9**

Thinking skills – Types of thinking skills – Concrete & Abstract thinking – Convergent & Divergent - Analytical & Creative thinking – Problem & Possibility thinking – Vertical & Lateral thinking – Problem solving skills – stages of problem solving skills – Decision making - intuition and reasoning skills - Thinking and language - The thinking process- concepts, problem solving, decision-making, creative thinking; language communication.

UNIT 5: PERSONALITY & INTELLIGENCE **9**

Psychological phenomena & Attributes of humans - cognition, motivation, and behavior - thoughts, feelings, perceptions, and actions – personality dimensions, traits, patterns - Specialized knowledge, performance accomplishments, automaticity or ease of functioning, skilled performance under challenge - generative flexibility, and speed of learning or behavior change.

TOTAL:45 PERIODS

REFERENCES

1. Morgan, C.T.and King, R.A (1994) Introduction to Psychology, Tata McGraw Hill Co Ltd, New Delhi.
2. Robert A. Baron (2002), Psychology, 5th Edition, Prentice Hall, India.
3. Michael W.Passer, Ronald E.smith (2007), Psychology: The science of mind and Behavior,3rd Edition Tata McGraw-Hill Edition.
4. Robert S.Feldman (2004) Understanding Psychology 6th Edition Tata McGraw – Hill.
5. Endler, N. S., & Summerfeldt, L. J. (1995). Intelligence. personality. psychopathology. and adjustment. In D. H. Saklofske & M. Zeidner (Eds.). International handbook of personality and intelligence (pp. 249-284). New York: Plenum Press.
6. Ford, M. E. (1994). A living systems approach to the integration of personality and intelligence. In R. J. Sternberg. & P. Ruzgis (Eds.). Personality and intelligence (pp. 188-21 7). New York: Cambridge University Press. De Bono, E (1990) Lateral Thinking, Harper Perennial, New York.

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	PSO 1	PSO 2	PSO 3
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CO.2						3	3	3	3	3	3	3			1
CO.3						3	3	3	3	3	3	3			1
CO.4						3	3	3	3	3	3	3			1
CO.5						3	3	3	3	3	3	3			1
CO						3	3	3	3	3	3	3			1

HU5175	EDUCATION, TECHNOLOGY AND SOCIETY	L	T	P	C
		3	0	0	3

COURSE DESCRIPTION

This course introduces students to multidisciplinary studies in Education, Technology and Society. Students will get an understanding of the relationship between education, technology and society. They will also learn about the long lasting impact of good education in a technologically advanced society.

COURSE OBJECTIVES:

The course aims

- To help learners understand the basics of different types of technology utilised in the field of education
- To make them realize the impact of education in society
- To make them evolve as responsible citizen in a technologically advanced society

LEARNING OUTCOMES

By the end of the course, learners will be able to

1. Understand the various apps of technology apps and use them to access, generate and present information effectively.
2. Apply technology based resources and other media formats equitably, ethically and legally.
3. Integrate their technical education for betterment of society as well as their personal life.

UNIT I INDIAN EDUCATION SYSTEM **9**

Gurukul to ICT education – Teacher as facilitator – Macaulay's Minutes – English medium vs Regional medium – Importance of Education in Modern India - Challenges in Education

UNIT II LEARNING THEORIES **9**

Learning Theories – Behaviorism – Cognitivism – Social Constructivism – Humanism Learning Styles –Multiple Intelligences – Emotional Intelligence – Blooms Taxonomy

UNIT III TECHNOLOGICAL ADVANCEMENTS **9**

Web tools – Social media in education – eLearning – MOOCs – Mobile assisted learning – Learning Apps – Blended learning - Self-directed learning

UNIT IV EDUCATIONAL TECHNOLOGY **9**

Technological implications on Education – Teaching, Learning & Testing with Technology - Advantages and drawbacks – Critical analysis on the use of technology

UNIT V ETHICAL IMPLICATIONS **9**

Plagiarism – Online Copyright issues – Ethical and value implications of education and technology on individual and society.

TOTAL:45 PERIODS

TEACHING METHODS

Teaching modes include guest lectures, discussion groups, presentations, visual media, and a practicum style of learning.

EVALUATION

As this is course is not a content based course, it focuses more on the ethical use of technology in education and society, and so, evaluation can be based on assignments and discussions. So there is no need for an end semester examination. Internals marks can be taken for the total marks.

INTERNAL (100 % WEIGHTAGE)

(a) Written Test (40 marks)
(b) Assignment: Write a real time report of the technology use in any school / college (15 marks)
(c) Presentation: Students choose any one of the technological tools and present its relevance to education and society (15 marks)
(d) Group discussion: Students discuss in groups on case studies relating to various challenges in education and technology use in society (20 marks)
(e) Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES

1) Education and Social order by Bertrand Russel
2) Theories of learning by Bower and Hilgard
3) Technology and Society by Jan L Harrington

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	PSO 1	PSO 2	PSO 3
CO.1						3	3	3	3	3	3	3			1
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CO.3						3	3	3	3	3	3	3			1
CO.4						3	3	3	3	3	3	3			1
CO.5						3	3	3	3	3	3	3			1
CO						3	3	3	3	3	3	3			1

HU5176	PHILOSOPHY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To create a new understanding by teaching philosophy through a comparison of Indian and Western traditions.
- To Fosters critical thinking and imagination by dealing with inter-related concepts in literature and science.
- To bridge the gap between the sciences and humanities through introspective analyses.
- To nurture an understanding of the self and elucidates ways to progress towards a higher understanding of one's self and others.

UNIT I KNOWLEDGE **9**

Knowledge (Vidya) Versus Ignorance (Avidya)- Brihadaranyaka Upanishad. Unity and Multiplicity – Isha Upanishad. What is True Knowledge? Ways to True Knowledge. Introduction to Philosophy of Yoga, Socratic Debate, Plato's Views. Asking and Answering Questions to Stimulate Critical Thinking and to Draw Ideas. Argumentative Dialogues. Dialectical Methods to Arrive at Conclusions.

UNIT II ORIGIN **9**

Origin of Universe And Creation – 'Nasidiya Sukta' in Relation With Big Bang Theory. Greek Concept of Chaos. The Concept of Space – Space as the Final Goal – Udgitha. Relationship Between Teacher And Student – The Knowledge Of Combinations, Body And Speech – Siksha Valli – Taittriya Upanishad.

UNIT III WORD **9**

Aum- Speech and Breath as Pair – Chandogya Upanishad and Brihadaryanaka Upanishad. Significance of Chants, Structure of Language and Cosmic Correspondences. The Non-Dual Word – Bhartrihari's Vakyapadiyam. Sphota-Ultimate Reality Expressed Through Language. Intention. Thought 'Sabdanaor' and Speaking.

UNIT IV KNOWLEDGE AS POWER/OPPRESSION **9**

Power- as Self-Realization in Gita. Krishna's Advice to Arjuna on How to Conquer Mind. Francis Bacon – Four Idols – What Prevents One From Gaining Knowledge? Michel Foucault- Knowledge as Oppression. Panopticon. Rtam (Truth) and Satyam (Eternal Truth).

UNIT V SELF KNOWLEDGE/BRAHMAN **9**

Knowledge about Self, Transcendental Self. The Different Chakras and the Stages of Sublimation. Philosophy of Yoga and Siva for Union of Mind and Body. Concept of Yin/Yang. Aspects of the Feminine / Masculine.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

1. Think sceptically, ask questions and to arrive at deductions.
2. Connect and relate different branches of thought.
3. Comprehends the relation between language, thought and action.
4. Arrive at a better understanding of self and others and forms a new outlook.

REFERENCES:

1. Swami Nikhilananda: The Upanishads, Swami Nikhilananda, Advaita Ashrama, Kolkata.
2. Swamy Tapasyananda: Srimad Bhagavad Gita, The Scripture of Mankind, Sri Ramakrishna Math, Chennai.
3. Subrahmanyam, Korada: Vakyapadiyam of Bhartrhari Brahmakanda, Sri Garib Dass series.
4. Swami Lokeswarananda: Chandogya Upanishad, Swami Lokeswarananda, Ramakrishna Mission Institute of Culture, Kolkata.
5. Brahma, Apuruseya: The Four Vedas: Translated in English.
6. Haich, Elizabeth: Sexual Energy and Yoga.
7. Bacon, Francis: Power as Knowledge
8. Vlastos, Gregory: Socrates Ironist and Moral Philosopher.
9. Plato: The Republic, Penguin.
10. Gutting, Garry: Foucault A Very Short Introduction, Oxford.

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	PSO 1	PSO 2	PSO 3
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CO.3						3	3	3	3	3	3	3			1
CO.4						3	3	3	3	3	3	3			1
CO						3	3	3	3	3	3	3			1

HU5177	APPLICATIONS OF PSYCHOLOGY IN EVERYDAY LIFE	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION **7**

Nature and fields.

UNIT II PSYCHOLOGY IN INDUSTRIES AND ORGANIZATIONS **9**

Job analysis; fatigue and accidents; consumer behavior.

UNIT III PSYCHOLOGY AND MENTAL HEALTH **11**

Abnormality, symptoms and causes psychological disorders

UNIT IV PSYCHOLOGY AND COUNSELING **7**

Need of Counseling, Counselor and the Counselee, Counseling Process, Areas of Counseling.

UNIT V PSYCHOLOGY AND SOCIAL BEHAVIOUR **11**

Group, group dynamics, teambuilding, Prejudice and stereotypes; Effective Communication, conflict and negotiation.

TOTAL: 45 PERIODS

TEXTBOOKS

1. Schultz, D. & Schultz, S.E. (2009). Psychology and Work Today (10th ed.). New Jersey:Pearson/Prentice Hall
2. Butcher, J. N., Mineka, S., & Hooley, J. M. (2010). Abnormal psychology (14th ed.). New York: Pearson
3. Gladding, S. T. (2014). Counselling: A comprehensive profession. New Delhi: Pearson Education
4. Aronson, E., Wilson, T. D., & Akert, R. M. (2010). Social Psychology (7th Ed.). Upper Saddle River, NJ: Prentice Hall

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	PSO 1	PSO 2	PSO 3
CO.1								3	1	2		3			1
CO.2								3	1	2		3			1
CO.3								3	1	2		3			1
CO.4								3	1	2		3			1
CO.5								3	1	2		3			1
CO								3	1	2		3			1

HSMC– ELECTIVES – HUMANITIES II (EVEN SEMESTER)

HU5271	GENDER, CULTURE AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE DESCRIPTION

This course offers an introduction to Gender Studies that asks critical questions about the meanings of sex and gender in Indian society. The primary goal of this course is to familiarize students with key issues, questions and debates in Gender Studies, both historical and contemporary drawing from Indian literature and media studies, to examine cultural assumptions about sex, gender, and sexuality. This course integrates analysis of current events through student presentations, aiming to increase awareness of contemporary and historical experiences of women, and of the multiple ways that sex and gender interact with class, caste and other social identities. This course also seeks to build an understanding of the concepts of gender, genderbased violence, sexuality, and rights and their impact on development through a number of discussions, exercises and reflective activities.

Objectives

1. To familiarize students with the concepts of sex and gender through literary and media texts.
2. To help students ask critical questions regarding gender roles in society.
3. To provide students with the material to discuss gender issues such as gender based discrimination, violence and development.
4. To help students think critically about gender based problems and solutions.
5. Learning Outcomes
6. Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
7. Students will be able to analyse current social events in the light of gender perspectives.
8. Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development.

UNIT I: Introduction to Gender

- Definition of Gender
- Basic Gender Concepts and Terminology
- Exploring Attitudes towards Gender
- Social Construction of Gender Texts:

1. Sukhu and Dukhu (Amar Chitra Katha)
2. The Cat who Became a Queen (Folk tale, J. Hinton Knowles, Folk-Tales of Kashmir. London: Kegan Paul, Trench, Trübner, and Company, 1893, pp. 8-10.)

UNIT II: Gender Roles and Relations

- Types of Gender Roles
- Gender Roles and Relationships Matrix
- Gender-based Division and Valuation of Labour Texts:

1. Muniyakka (Short Story, Lakshmi Kannan, Nandanvan and Other Stories, Hyderabad: Orient Blackswan, 2011)
2. Video: Witness: Freeing Women From Cleaning Human Waste (2014, HRW, Manual Scavenging, India)

UNIT III: Gender Development Issues

- Identifying Gender Issues
- Gender Sensitive Language
- Gender, Governance and Sustainable Development
- Gender and Human Rights
- Gender and Mainstreaming Texts:

1. The Many Faces of Gender Inequality (Essay, Amartya Sen, Frontline, Volume 18 - Issue 22, Oct. 27 - Nov. 09, 2001)
2. Tell Us Marx (Poem, Mallika Sengupta, Translated by Sanjukta Dasgupta)

UNIT IV: Gender-based Violence

- The concept of violence
- Types of Gender-based violence
- The relationship between gender, development and violence
- Gender-based violence from a human rights perspective Texts:

1. Lights Out (Play, Manjula Padmanabhan)
2. Lights Out (Video of play enacted)

UNIT V: Gender and Culture

- Gender and Film
- Gender, Media and Advertisement

Texts:

1. Mahanagar (Movie: Satyajit Ray)
2. Beti Bachao Beti Padhao Advertisements

READINGS: Relevant additional texts for readings will be announced in the class. Classes will consist of a combination of activities: dialogue-based lectures, discussions, collaborative learning activities, group work and in-class assignments.

ASSESSMENT AND GRADING:
Discussion & Classroom Participation: 20%
Project/Assignment: 30%
End Term Exam: 50%

COURSE OUTCOMES
After completion the above subject, students will be able to understand
CO1: Students will be able to critically read literary and media texts and understand the underlying gender perspectives in them.
CO2: Students will be able to analyse current social events in the light of gender perspectives.
CO3: Students will be able to discuss, analyse and argue about issues related to gender and their impact on society, culture and development. 158
CO4: Students will be able to know the concept of violence
CO5: Students will be able to know the gender and culture

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	PSO 1	PSO 2	PSO 3
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CO.2								3	2	2		3			1
CO.3								3	2	2		3			1
CO.4								3	2	2		3			1
CO.5								3	2	2		3			1
CO.6								3	2	2		3			1
CO								3	2	2		3			1

HU5272	ETHICS AND HOLISTIC LIFE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To emphasize the meaning and nature of ethics, human values and holistic life for leading a good, successful and happy life through continuous examination of thoughts and conduct in day to day life.
- To understand the status and responsible role of individual in abatement of value crisis in contemporary world in order to develop a civilized and human society. Understanding the process of ethical decision making through critical assessment of incidents/cases of ethical dilemmas in personal, professional and social life.
- To view the place of Ethics and Human Values in the development of individual and society through identification and cross examination of life values and world view of his/her role models in society.

UNIT I HUMAN LIFE, ITS AIM AND SIGNIFICANCE

The concept of a successful life, happy life and a meaningful life, Ethical and decision making capability and its development: Meaning of Ethical dilemma, sharing real life experiences.

UNIT II CREATIVE AND LEADERSHIP ABILITY AND THEIR DEVELOPMENT

Intellectual, Emotional, Creative, Ethico - spiritual development, Aesthetic sense, Selfdependency, Activeness, Development of positive attitude.

UNIT III HARMONY IN PERSONAL AND SOCIAL LIFE:

Concept of personal and group Ethics; Balance between - rights and duties-welfare of self and welfare of all, Creating a value based work culture in hostel, classroom and other places in the campus and society.

UNIT IV CHARACTER, RIGHTEOUSNESS AND VIRTUES FOR A MEANINGFUL LIFE

Egolessness, Humility, Righteousness, Purity, Truthfulness, Integrity, Self-restraint, Self-control, Sense of responsibility, Empathy, Love, Compassion, Maitri / Comradeship, Cooperation, Tolerance.

UNIT V DILEMMA BETWEEN MATERIALISTIC DEVELOPMENT AND HUMAN WELFARE

Science, Technology, Consumerism, Relation with Nature and Environment, New dimension of Global Harmony: Democracy, Equality, Social Justice

TOTAL:45 PERIODS

OUTCOMES:

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

1. Enable students to understand the concept of contemporary ethics at different levels: Individual, local and Global and enable them to cross examine the ethical and social consequences of the decisions of their life-view and world view.
2. Develop the ability of students to create a balance between their individual freedom and social responsibilities and enable them to identify the personal, professional and social values and integrate them in their personality after cross examination.
3. Enable students to cross examine their earlier decisions taken in life and understand the meaning of ethical dilemma to overcome the ethical dilemmas and engage in critical reflection.
4. Develop positive habits of thought and conduct and work cohesively with fellow beings who have variety of strengths, experiences, shortcomings and challenges, hence to enable them to handle diverse type of personalities.
5. Enable students to develop a method for making ethically sound decisions for themselves, within hostels, classrooms, university campus and society.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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CO.3								3	2	2	1	3			1
CO.4								3	2	2	1	3			1
CO.5								3	2	2	1	3			1
CO.6								3	2	2	1	3			1
CO								3	2	2	1	3			1

HU5273	LAW AND ENGINEERING	L	T	P	C
		3	0	0	3

UNIT I THE LEGAL SYSTEM: SOURCES OF LAW AND THE COURT STRUCTURE 9

Enacted law -Acts of Parliament are of primary legislation, Common Law or Case law- Principles taken from decisions of judges constitute binding legal rules. The Court System in India and Foreign Courtiers. (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court) Arbitration: As an alternative to resolving disputes in the normal courts, parties who are in dispute can agree that this will instead be referred to arbitration.

UNIT II LAWS 9

Basic principles of contract law, sale of goods law, laws relating to industrial pollution, accident, environmental protection, health and safety at work, patent law, constitutional law: the supreme law of the land, Information technology law and cyber crimes.

UNIT III BUSINESS ORGANISATIONS 9

Sole traders (Business has no separate identity from you, all business property belongs to you).
Partnerships: Types of Partnerships - Limited Liability Partnership, General Partnership, Limited Partnerships. Companies: The nature of companies, Classification of companies, Formation of companies, Features of a public company, Carrying on business, Directors– Their Powers and Responsibilities/Liabilities.

UNIT IV LAW AND SOCIETY 9

Interdisciplinary nature of law, legal ideologies/philosophy/ schools of jurisprudence.

UNIT V CASE STUDIES 9

Important legal disputes and judicial litigations

TOTAL: 45 PERIODS

COURSE OUTCOMES

After completion the above subject, students will be able to understand
CO1: Know the structure of law system.
CO2: Understand the types of laws.
CO3: Know the different types of organizations.
CO4: Understand the development of law for the society.
CO5: Know the important issues in legal disputes.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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CO.5						2		3	2	2	1	3			1
CO.6						2		3	2	2	1	3			1
CO						2		3	2	2	1	3			1

HU5274	FILM APPRECIATION	L	T	P	C
		3	0	0	3

COURSE DESCRIPTION

This is an intensive course designed to promote comprehensive understanding and insights into the nature of cinema and other related forms and practices. Movies, though at times are used more as escapism, they are also a true art form and expressive tool used by writers, directors and actors. This course will explore the aesthetics of cinema, the concepts behind storytelling and various other elements of a film. It will also

explore the impact of movies in our society and in our lives. It also encourages students to use films as a medium to analyse visual texts and read underlying messages.

OBJECTIVES:

- To help learners understand the various movie genres and its types.
- To understand various elements that contributes to film making.
- To make them realize the impact of film in society.
- To analyse the visual media and interpret the underlying messages.

UNIT I THE COMPONENTS OF FILMS 9

Story, Screenplay & Script – Actors – Director – Crew Members – Mis En Scene – Structure of A Film – Narrative Elements – Linear & Non-Linear – Types of Movie Genres: Mysteries, Romantic Comedies, Horror Etc.

UNIT II EVOLUTION OF FILM 9

History of Films – Early Cinema – Silent Movies – Talkies – Film Language, Form, Movement – Film Theories – Realist, Auteurists, Feminist, Psychonalyic, Idealogical Theories.

UNIT III FILMS ACROSS THE WORLD 9

European Films – Russian Films – Japanese Films – Korean Films – Hollywood Film – Studio Culture – All Time Great Movies.

UNIT IV INDIAN FILMS 9

The Early Era – History Of Indian Cinema – Movies for Social Change – Hindi Movies that Created Impact – Regional Movies – Documentaries – Cultural Identity.

UNIT V INTERPRETING FILMS 9

Film Criticism & Appreciation – Censorship in Movies – Cultural Representation in Movies – Television – New Media & Online Media – Films Beyond Entertainment.

TOTAL: 45 PERIODS OUTCOMES

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

1. Recognize types of films, their impact on society and their roles in our lives.
2. Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.
3. Interpret the underlying messages in the movies.

Teaching Methods

 Each unit consists of reading materials, learning activities videos, websites. Students are expected to watch movies sometimes in class and at times at home and discuss in class.

Evaluation

 As this is course is critical appreciation course on films, there is no written end semester examination. The course is more on learning how to critically analyse a movie and appreciate its finer elements. Therefore evaluation can be based on assignments and discussions. Internals marks can be taken for the total marks.

Internal (100 % weightage)

- Assignment 1: Write a movie review with critical analysis (20 marks).
- Assignment2 : Write a script for a scene taken from a short story / novella (20 marks).
- Presentation: Students choose any one topic related to films and present it to the audience. (25 marks)
- Group discussion : Students discuss in groups on the various aspects of movies and its impact on society. (25 marks)
- Blog entry: Making weekly blog posts in Class Blog on the topics related to the course posted by the instructor and commenting on others' posts. (10 marks)

REFERENCES

1. A Biographical Dictionary of Film by David Thomson, Secker & Warburg, 1975
2. Signs and Meaning in the Cinema by Peter Wollen, Secker & Warburg, 1969
3. The World Viewed by Stanley Cavell 1971

4. Film Style and Technology: History and Analysis by Barry Salt, Starword, 1983
5. The Encyclopedia of Indian Cinema Edited by Ashish Rajadhyaksha and Paul Willemen, BFI, 1994.

COURSE OUTCOMES

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

CO1: Recognize types of films, their impact on society and their roles in our lives.

CO2: Have an understanding of the concepts of storytelling, Mise en Scene, and other elements of film making.

CO3: Interpret the underlying messages in the movies.

CO4: Know the principles in interpreting the films.

CO5: Know the history of Indian cinema.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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CO.5								3	2	2	1	3			1
CO.6								3	2	2	1	3			1
CO								3	2	2	1	3			1

HU5275	FUNDAMENTALS OF LANGUAGE AND LINGUISTICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To broadly introduce students to the formal and theoretical aspects of linguistics.
- To enable learners to understand the various practical applications of language and recent findings in the field of applied linguistics.

CONTENTS : -

UNIT I LANGUAGE AND LINGUISTICS: AN OVERVIEW 9

Language and Linguistics-Linguistic Knowledge-Knowledge of Sound Systems & Words – Creativity of Language – Relationship of form and meaning. Grammar – descriptive, prescriptive,universal-Human Language – Animal Language – Sign Language- Computers and Language.

UNIT II MORPHOLOGY - WORDS OF LANGUAGE 9

Content and function words – morphemes -free & bound –prefixes – suffixes – roots and stems – inflectional and derivational morphology-compound words and their formation – malapropisms – slips of the tongue.

UNIT III SYNTAX- THE SENTENCE PATTERNS OF LANGUAGE AND SEMANTICS-THE MEANING OF LANGUAGE 9

Syntax : Rules of Syntax- Sentence Structure-Structural Ambiguity-Syntactic Categories. Semantics: Lexical Semantics – Anomaly-Metaphors- Idioms- Synonyms – Antonyms – Homonyms -Pragmatics– Speech Acts

UNIT IV PHONETICS – THE SOUNDS OF LANGUAGE 9

Speech sounds- Introduction to branches of Phonetics- The Phonetic Alphabet – IPA – Consonants - Vowels – Diphthongs- Tone and Intonation.

UNIT V APPLIED LINGUISTICS - THE PRACTICAL APPLICATIONS OF LANGUAGE 9

Language learning and teaching (ELT)- lexicography-translation studies-computational linguisticsneurolinguistics (speech pathology and language disorders)- forensic linguistics – sociolinguistics.

TOTAL : 45 PERIODS

Teaching Methods : Lectures, discussion.

Evaluation Internal and External :
Internal: 2 written tests + assignments, seminars, project (50+15+15+20). External: A 3 hour written exam (50 marks)

REFERENCES :

1. Victoria Fromkin, Robert Rodman, Nina Hyams.2019.An Introduction to Language.USA.CENGAGE.11th edition
2. Cook. G,2003. Applied linguistics.UK: Oxford University Press.

COURSE OUTCOMES

After completion the above subject, students will be able to understand
CO1: Know the overview of language
CO2: Understand the words of language 163
CO3: Know the syntax of sentence pattern
CO4: Understand the sounds of language
CO5: Know the practical application of language.

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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CO.5								3	3	2	1	3			1
CO.6								3	3	2	1	3			1
CO								3	3	2	1	3			1

HU5276	UNDERSTANDING SOCIETY AND CULTURE THROUGH LITERATURE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To internalize the importance of language by understanding its role in the transformation of man.
- To look at language, literature and culture as locus of identity and change.
- To extract meaning from existing literatures and cultures.
- To identify meanings in modern life by reconnecting with lost cultures.

Unit 1 Introduction

Why study literature? Tracing the origin – pictures. Tokens as precursors of writing. Movement from three dimensions to two dimensions- Pictography. From visual to oral -Logography. Reading out literature to young children- Edmund J Farrell.

Unit 2. Reading Culture

Reading culture through language, signs and consumables- Roland Barthes. Culture through poems- Nissim Ezekiel's ' The night of the Scorpion' . 'Nothing's Changed'- Tatamkhulu Afrika- Apartheid. Ruskin Bond- 'Night train at Deoli'- How real life is different from movies.

Unit 3. Identifying Meaning

Searching and locating meaning through literature. Looking for order in a chaotic world. The Myth of Sisyphus (Albert Camus) and Adi Shankar's 'Jagat Mithya'- the world as an illusion. The Indian version as 'meaninglesss meaning'.

Unit 4. Post Modernism

'If on a winter's night a traveler'- Italo Calvino. The book about the reader- the experience of reading as reading. Metafiction. Selfie Culture. Visual Culture as purpose of modern life.

Unit 5. Returning to Pictures

Literature of the present- Emphasis on the visual world. Twitterature. SMS. Whatsapp language. Consumer culture. Change in fixed gender notions. Interactive sessions. Introspection.

Reading list

1. Bond, Ruskin: 'Night train at Deoli'
2. Ezekiel, Nissim: ' The Night of the Scorpion'
3. Afrika,Tatamkhulu: 'Nothing's Changed'
4. Barthes, Roland: Mythologies
5. Shankaracharya: Viveka Chudamani
6. Camus, Albert- The Myth of Sisyphus
7. Calvino, Italo: If on a winter's night a traveler
8. Farrell, Edmund J: 'Listen, my children, and you shall read'

COURSE OUTCOME

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

CO1: Identify the connections among language, literature and culture.
CO2: To relate between seemingly different aspects of life.
CO3: Understands the fractions in modern life and can assimilate meanings.
CO4: Know the different type of culture.
CO5: Understand the development in the visual world

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

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CO.6															1
CO								3	3	3	2	3			1