SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur, Chengalpattu Dt.-603203, Tamil Nadu.

DEPARTMENT OF

ELECTRONICS AND COMMUNICATION ENGINEERING

UNDER GRADUATE

CURRICULA AND SYLLABI

(REGULATIONS 2019)

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

REGULATIONS – 2019

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To prepare students to succeed in employment/profession and/or to pursue post graduate and research educations in Electronics and Communication Engineering discipline in particular and allied engineering disciplines in general.
2. To provide students with a solid foundation in mathematical, Scientific and engineering fundamentals required to formulate, analyze and solve engineering problems requiring knowledge of Electronics and Communication Engineering.
3. To prepare students with engineering breadth to innovate, design, develop electronics products and to contribute in providing solutions related to multidisciplinary real life problems.
4. To inculcate in students professional and ethical attitude, effective communication skills and teamwork to become a successful professional.
5. To provide students with an academic environment that makes them aware of excellence and life-long learning in emerging technologies.

2. PROGRAMME OUTCOMES (POs):

After going through the four years of study, our Electronics and Communication Engineering Graduates will exhibit ability to:

PO#	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3	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 public health and safety, and cultural, societal, and environmental considerations.
4	Conduct investigations of complex problems	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6	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
7	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.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with the 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
11	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
12	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

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Electronics and Communication Engineering program the student will have following Program specific outcomes

1. Ability to apply the acquired knowledge of basic skills, mathematical foundations, principles of electronics, modeling and design of electronics based systems in solving engineering Problems.
2. Ability to understand and analyze the interdisciplinary problems for developing innovative sustained solutions with environmental concerns.
3. Ability to update knowledge continuously in the tools like MATLAB, NS2, XILINIX and technologies like VLSI, Embedded, Wireless Communications to meet the industry requirements.
4. Ability to manage effectively as part of a team with professional behavior and ethics.

4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
I	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓		
II	✓	✓	✓	✓	✓	✓	✓	✓					✓		✓	✓
III	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	
IV						✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
V					✓	✓	✓		✓	✓	✓	✓	✓	✓		✓

MAPPING – UG - ELECTRONICS AND COMMUNICATION ENGINEERING

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year I	Sem I	Communicative English	3	3	3	2	3	3	2			3		1	1	1	1	1
		Engineering Mathematics-I	3	2	2	1								1				
		Engineering Physics	3	1	1	1	1	1	1					1	3	1		
		Engineering Chemistry	2	2	2	1	1	1	1				1	2	2	2	1	2
		Programming in C	3	2	3	2	2	1	1		2		1	1	3	2	2	3
		Engineering Graphics	2		3						1	3		1	2	1	1	1
		Physics and Chemistry Laboratory	3	2	1	2		1	2	1	1			1	2	2	1	
		C Programming Laboratory	3	2	3	2	2	2		3	1	1	2	1	2	2	2	2
Year I	Sem II	Technical English	3	2	2	2					3	3	2	1	1	1	1	2
		Engineering Mathematics-II	3	2	1	1								1				
		Physics for Electronics Engineering	3	2	2		1	1	1						2	1		
		Environmental Science and Engineering	2	2		2		1	2	2			1	2	2	2	1	1
		Problem Solving and Python Programming	3			2	2	2				2	2	2		2	2	3
		Basic Civil and Mechanical Engineering	3	2	2	1		2	2	1				1	2	1	1	2
		Problem Solving and Python Programming Laboratory	3	2	2	1	3	2		1			2	3		3		
		Engineering Practices Laboratory	3	2	2	2	2	1			1		1	1				
		Applied Physics and Environmental Chemistry Laboratory	3	2	2	2		2	2	1	1			1	2	1	1	1
		NSS/NCC/YRC/NSO																

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year II	Sem III	Transforms and Partial Differential Equations	3	3			1							1				
		Electronic Devices and circuits	3	3	2									2	2			
		Analog Electronics-I	3	3	3	3								2	3	1	3	
		Signals and Systems	3	2	1	2								1	2	2		
		Digital Electronics	3	3	2	2	3	2						1	2	1	2	
		Control Systems Engineering	1	1	1	1	1	2	1	2	1	1	1	2	2	2	3	2
		Electronic Devices and circuits Laboratory	3	3	2	2	3			1	2		2	2	2	2	3	2
		Analog and Digital Electronics Laboratory	3	2	2	2	3	2			3	3		2	3	3	3	1
		Communication Skills Laboratory - Project based	3	3	2	2	3		3			3		1	2	1	1	2
Year II	Sem IV	Probability and Random Processes	3	3	3	2	1						1	1	1			
		Linear Integrated Circuits	3	3	3	2								2	2	2		
		Analog Electronics-II	3	3	3	3								2	3	1	3	
		Communication Theory	3	2	2	2		3	3	3		2		1	3	2		
		Electromagnetic Fields	3	2	3	3		2	1	2				2	2	1	2	
		Professional Ethics						3	3	2						1		1
		Linear Integrated Circuits Laboratory	3	3	3	2	3	1			2	2		2	2	2	3	
		Circuits Design and Simulation Laboratory	3	2	2	2	3	2			3	3		2	3	3	3	1

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year III	Sem V	Discrete Time Signal Processing	3	2	2	2		3	3	3	2	2		1	3	2		3
		Digital Communication	3	3	3	3			2	2				2	2	2		
		Communication Networks	1	2	2	1		1	1	3				2	2	1		
		Transmission Lines and RF Systems	3	3	2	2								2	3	2		
		Professional Elective-I																
		Open Elective-I																
		Digital Signal Processing Laboratory	3	2	2	2	2		2	2	2	3	1	2	2	2	3	2
		Communication Systems and Networks Laboratory	3	3	2	3	3	2	2	2	3	2		2	2	2	3	
		Professional Communication	3	2	2	3	3		3			3		1	2	1	1	2
Year III	Sem VI	Microprocessors and Microcontrollers	2	1	2	1	3	1		2				2	2	1	3	
		VLSI Design	3	3	3	2	3	1	2	2				2	3	2	1	
		Embedded and Real Time Systems	1	2	2	3	3	2	2	2			2	2	2	2	2	
		Wireless Networks	2	2	3	1								2	2	2	2	
		Professional Elective -II																
		Professional Elective -III																
		Microcontrollers and Embedded Laboratory	2	2	3	2	3	2	2	2	2	2		2	2	2	3	
		VLSI Design Laboratory	3	3	3	2	3	1				1	2		3	2	1	
		Mini Project	2	3	3	2		1	2	2	3	3	3	3	2	2	1	2

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year IV	Sem VII																	
		Antennas and Microwave Engineering	3	3	1	3	3	2	2	3		2	2		2	3		3
		Optical Communication	3	3	2	2		2						2	3	3		
		Wireless Communication	2	2	3	3		2						3	2	1	2	
		Digital Image Processing	3	2	2	2								2	2	2		
		Open Elective-II																
		Advanced Communication Laboratory	3	3	1	3	3	2		2	3	2	2	2	2	3	3	3
		Project work Phase-I	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3
		Internship	2	1	1	1	2	2	2	2	2	2	2	2	1	2	2	2
Year IV	Sem VIII	Professional Elective-IV																
		Professional Elective-V																
		Project work Phase-II	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3

1 - Reasonable, 2 - Significant, 3 - Strong

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

BRANCH: ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM

REGULATIONS – 2019

SEMESTER I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1919101	Communicative English	HS	3	3	0	0	3
2.	1918102	Engineering Mathematics-I	BS	4	3	1	0	4
3.	1920103	Engineering Physics	BS	3	3	0	0	3
4.	1921104	Engineering Chemistry	BS	3	3	0	0	3
5.	1901006	Programming in C	ES	3	3	0	0	3
6.	1901007	Engineering Graphics	ES	6	2	0	4	4
PRACTICAL								
7.	1901108	Physics and Chemistry Laboratory	BS	4	0	0	4	2
8.	1901010	C Programming Laboratory	ES	4	0	0	4	2
			TOTAL	**30**	**17**	**01**	**12**	**24**

SEMESTER II

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1919201	Technical English	HS	3	3	0	0	3
2.	1918202	Engineering Mathematics-II	BS	4	3	1	0	4
3.	1920203	Physics for Electronics Engineering	BS	3	3	0	0	3
4.	1921203	Environmental Science and Engineering	BS	3	3	0	0	3
5.	1901005	Problem Solving and Python Programming	ES	3	3	0	0	3
6.	1901008	Basic Civil and Mechanical Engineering	ES	3	3	0	0	3
PRACTICAL								
7.	1901009	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
8.	1901208	Engineering Practices Laboratory	ES	4	0	0	4	2
9.	1901209	Applied Physics and Environmental Chemistry Laboratory	BS	4	0	0	4	2
10.	1901200	NSS/NCC/YRC/NSO	PCD	2*	0	0	2	1
			TOTAL	**33**	**18**	**01**	**14**	**26**

*Conducted after college hours

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SEMESTER III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1918301	Transforms and Partial Differential Equations	BS	4	3	1	0	4
2.	1906301	Electronic Devices and circuits	PC	3	3	0	0	3
3.	1906302	Analog Electronics-I	PC	3	3	0	0	3
4.	1906001	Signals and Systems	PC	3	3	0	0	3
5.	1906303	Digital Electronics	PC	3	3	0	0	3
6.	1905009	Control Systems Engineering	PC	3	3	0	0	3
PRACTICAL								
7.	1906304	Electronic Devices and circuits Laboratory	PC	4	0	0	4	2
8.	1906305	Analog and Digital Electronics Laboratory	PC	4	0	0	4	2
9.	1919001	Communication Skills Laboratory - Project based	EEC	2	0	0	2	-
			TOTAL	**29**	**18**	**01**	**10**	**23**

SEMESTER IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1918403	Probability and Random Processes	BS	4	3	1	0	4
2.	1906401	Linear Integrated Circuits	PC	3	3	0	0	3
3.	1906402	Analog Electronics-II	PC	3	3	0	0	3
4.	1906403	Communication Theory	PC	3	3	0	0	3
5.	1906404	Electromagnetic Fields	PC	3	3	0	0	3
6.	1915001	Professional Ethics	HS	3	3	0	0	3
PRACTICAL								
7.	1906405	Linear Integrated Circuits Laboratory	PC	4	0	0	4	2
8.	1906406	Circuits Design and Simulation Laboratory	PC	4	0	0	4	2
			TOTAL	**27**	**18**	**01**	**8**	**23**

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SEMESTER V

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1906002	Discrete Time Signal Processing	PC	3	3	0	0	3
2.	1906501	Digital Communication	PC	3	3	0	0	3
3.	1906502	Communication Networks	PC	3	3	0	0	3
4.	1906503	Transmission Lines and RF Systems	PC	3	3	0	0	3
5.	19xxxxx	Professional Elective-I	PE	3	3	0	0	3
6.	19xxxxx	Open Elective-I	OE	3	3	0	0	3
PRACTICAL								
7.	1906003	Digital Signal Processing Laboratory	PC	4	0	0	4	2
8.	1906508	Communication Systems and Networks Laboratory	PC	4	0	0	4	2
9.	1919002	Professional Communication	EEC	2	0	0	2	1
			TOTAL	**26**	**18**	**0**	**10**	**23**

SEMESTER VI

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1906601	Microprocessors and Microcontrollers	PC	3	3	0	0	3
2.	1906005	VLSI Design	PC	3	3	0	0	3
3.	1906008	Embedded and Real Time Systems	PC	3	3	0	0	3
4.	1906602	Wireless Networks	PC	3	3	0	0	3
5.	19xxxxx	Professional Elective -II	PE	3	3	0	0	3
6.	19xxxxx	Professional Elective -III	PE	3	3	0	0	3
PRACTICAL								
7.	1906605	Microcontrollers and Embedded Laboratory	PC	4	0	0	4	2
8.	1906606	VLSI Design Laboratory	PC	4	0	0	4	2
9.	1906607	Mini Project	EEC	4	0	0	4	2
			TOTAL	**30**	**18**	**0**	**12**	**24**

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SEMESTER VII

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1906701	Antennas and Microwave Engineering	PC	3	3	0	0	3
2.	1906702	Optical Communication	PC	3	3	0	0	3
3.	1906703	Wireless Communication	PC	3	3	0	0	3
4.	1906704	Digital Image Processing	PC	3	3	0	0	3
5.	19xxxxx	Open Elective-II	OE	3	3	0	0	3
PRACTICAL								
6.	1906708	Advanced Communication Laboratory	PC	4	0	0	4	2
7.	1906709	Project Work-Phase I	EEC	4	0	0	4	2
8.	1906710	Internship	EEC	0	0	0	0	1
			TOTAL	**25**	**15**	**0**	**8**	**20**

SEMESTER VIII

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	19xxxxx	Professional Elective-IV	PE	3	3	0	0	3
2.	19xxxxx	Professional Elective-V	PE	3	3	0	0	3
PRACTICAL								
3.	1906810	Project work – Phase II	EEC	12	0	0	12	6
			TOTAL	**18**	**6**	**0**	**12**	**12**

TOTAL NO. OF CREDITS: 175

HUMANITIES AND SOCIALSCIENCES (HS)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1919101	Communicative English	HS	3	3	0	0	3
2.	1919201	Technical English	HS	3	3	0	0	3
3.	1915001	Professional Ethics	HS	3	3	0	0	3

BASIC SCIENCES (BS)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1918102	Engineering Mathematics-I	BS	4	4	0	0	4
2.	1920103	Engineering Physics	BS	3	3	0	0	3
3.	1921104	Engineering Chemistry	BS	3	3	0	0	3
4.	1901108	Physics and Chemistry Laboratory	BS	4	0	0	4	2
5.	1918202	Engineering Mathematics-II	BS	4	4	0	0	4
6.	1920203	Physics for Electronics Engineering	BS	3	3	0	0	3
7.	1921203	Environmental Science and Engineering	BS	3	3	0	0	3
8.	1901209	Applied Physics and Environmental Chemistry Laboratory	BS	4	0	0	4	2
9.	1918301	Transforms and Partial Differential Equations	BS	4	3	0	0	3
10.	1918403	Probability and Random Processes	BS	4	3	0	0	3

ENGINEERING SCIENCES (ES)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1901106	Programming in C	ES	3	3	0	0	3
2.	1901107	Engineering Graphics	ES	6	2	0	4	4
3.	1901010	C Programming Laboratory	ES	4	0	0	4	2
4.	1901005	Problem Solving and Python Programming	ES	3	3	0	0	3
5.	1901008	Basic Civil and Mechanical Engineering	ES	3	3	0	0	3

6.	1901009	Problem Solving and Python Programming Laboratory	ES	4	0	0	4	2
7.	1901208	Engineering Practices Laboratory	ES	4	0	0	4	2

PROFESSIONAL CORE (PC)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1906301	Electronic Devices and circuits	PC	3	3	0	0	3
2.	1906302	Analog Electronics-I	PC	3	3	0	0	3
3.	1906001	Signals and Systems	PC	3	3	0	0	3
4.	1906303	Digital Electronics	PC	3	3	0	0	3
5.	1906303	Digital Electronics	PC	3	3	0	0	3
6.	1905408	Control Systems Engineering	PC	3	3	0	0	3
7.	1906304	Electronic Devices and circuits Laboratory	PC	4	0	0	4	2
8.	1906305	Analog and Digital Electronics Laboratory	PC	4	0	0	4	2
9.	1906401	Linear Integrated Circuits	PC	3	3	0	0	3
10.	1906402	Analog Electronics-II	PC	3	3	0	0	3
11.	1906403	Communication Theory	PC	3	3	0	0	3
12.	1906404	Electromagnetic Fields	PC	3	3	0	0	3
13.	1906405	Linear Integrated Circuits Laboratory	PC	4	0	0	4	2
14.	1906406	Circuits Design and Simulation Laboratory	PC	4	0	0	4	2
15.	1906002	Discrete Time Signal Processing	PC	3	3	0	0	3
16.	1906501	Digital Communication	PC	3	3	0	0	3
17.	1906502	Communication Networks	PC	3	3	0	0	3
18.	1906503	Transmission Lines and RF Systems	PC	3	3	0	0	3
19.	1906003	Digital Signal Processing Laboratory	PC	4	0	0	4	2
20.	1906508	Communication Systems and Networks Laboratory	PC	4	0	0	4	2
21.	1906601	Microprocessors and Microcontrollers	PC	3	3	0	0	3
22.	1906005	VLSI Design	PC	3	3	0	0	3
23.	1906008	Embedded and Real Time Systems	PC	3	3	0	0	3

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24.	1906602	Wireless Networks	PC	3	3	0	0	3
25.	1906605	Microcontrollers and Embedded Laboratory	PC	4	0	0	4	2
26.	1906606	VLSI Design Laboratory	PC	4	0	0	4	2
27.	1906701	Antennas and Microwave Engineering	PC	3	3	0	0	3
28.	1906702	Optical Communication	PC	3	3	0	0	3
29.	1906703	Wireless Communication	PC	3	3	0	0	3
30.	1906704	Digital Image Processing	PC	3	3	0	0	3
31.	1906708	Advanced Communication Laboratory	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1919001	Communication Skills Laboratory-Project based	EEC	2	0	0	2	-
2.	1919002	Professional Communication	EEC	2	0	0	2	1
3.	1906607	Mini Project	EEC	4	0	0	4	2
4.	1906710	Internship	EEC	0	0	0	0	1
5.	1906709	Project Work – Phase I	EEC	4	0	0	4	2
6.	1906810	Project Work – Phase II	EEC	12	0	0	12	6

PERSONALITY AND CHARACTER DEVELOPMENT (PCD)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1901200	NSS/NCC/YRC/NSO	PCD	2	0	0	2	1

PROFESSIONAL ELECTIVES (PE)

SEMESTER V

PROFESSIONAL ELECTIVE-I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1906504	Sensor Technology	PE	3	3	0	0	3
2.	1906009	Medical Electronics	PE	3	3	0	0	3
3.	1904511	Operating Systems	PE	3	3	0	0	3
4.	1907002	Robotics and Automation	PE	3	3	0	0	3
5.	1921503	Nanotechnology and Applications	PE	3	3	0	0	3

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SEMESTER VI

PROFESSIONAL ELECTIVE-II

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1906603	Cryptography and Network Security	PE	3	3	0	0	3
2.	1906007	Advanced Digital Signal Processing	PE	3	3	0	0	3
3.	1908609	Internet of Things and Its Applications	PE	3	3	0	0	3
4.	1906604	Multimedia Compression and Communication	PE	3	3	0	0	3
5.	1915002	Principles of Management	PE	3	3	0	0	3

SEMESTER VI

PROFESSIONAL ELECTIVE-III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1904609	Soft Computing	PE	3	3	0	0	3
2.	1904006	Artificial Intelligence	PE	3	3	0	0	3
3.	1904012	Machine Learning	PE	3	3	0	0	3
4.	1904011	Big Data Analytics	PE	3	3	0	0	3
5.	1920001	Fundamentals of Nanoscience	PE	3	3	0	0	3

SEMESTER VIII

PROFESSIONAL ELECTIVE-IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1906801	Radar and Navigational Aids	PE	3	3	0	0	3
2.	1906802	RF System Design	PE	3	3	0	0	3
3.	1906803	Cognitive Radio	PE	3	3	0	0	3
4.	1906804	Mixed Signal IC Design	PE	3	3	0	0	3
5.	1906004	Electronics Packaging and Testing	PE	3	3	0	0	3

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SEMESTER VIII

PROFESSIONAL ELECTIVE-V

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1906805	Electro Magnetic Interference and Compatibility	PE	3	3	0	0	3
2.	1906806	Satellite Communication	PE	3	3	0	0	3
3.	1906807	Advanced Wireless Communication	PE	3	3	0	0	3
4.	1906808	Ad Hoc and Wireless Sensor Networks	PE	3	3	0	0	3
5.	1906809	Advanced Microprocessors and Microcontrollers	PE	3	3	0	0	3

OPEN ELECTIVE – I (V SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	Course offering Department	CONTACT PERIODS	L	T	P	C
1.	1902512	Environment and Agriculture	AGRI	3	3	0	0	3
2.	1902513	Production Technology of Agricultural Machinery	AGRI	3	3	0	0	3
3.	1903514	Air Pollution and Control Engineering	CIVIL	3	3	0	0	3
4.	1903515	Participatory Water Resources Management	CIVIL	3	3	0	0	3
5.	1904504	Geographic Information System	CSE	3	3	0	0	3
6.	1904007	Data Structures	CSE	3	3	0	0	3
7.	1904508	Database management system	CSE	3	3	0	0	3
8.	1904509	Cloud computing	CSE	3	3	0	0	3
9.	1905001	Energy Conservation and Management	EEE	3	3	0	0	3
10.	1905508	Renewable Energy Sources	EEE	3	3	0	0	3
11.	1905509	SCADA System Management	EEE	3	3	0	0	3
12.	1907503	Sensors and Transducers	EIE	3	3	0	0	3
13.	1907504	Instrumentation in Biomedical Engineering	EIE	3	3	0	0	3
14.	1908001	3D Printing and Design	IT	3	3	0	0	3
15.	1908002	Scripting Languages	IT	3	3	0	0	3
16.	1909510	Product Design and Development	MECH	3	3	0	0	3
17.	1909511	Vibration and Noise Control	MECH	3	3	0	0	3
18.	1909512	Industrial Safety Engineering	MECH	3	3	0	0	3
19.	1910504	Principles of Food Preservation	MEDICAL ELECTRONICS	3	3	0	0	3
20.	1920501	Nanotechnology	PHYSICS	3	3	0	0	3
21.	1920502	Microscopy	PHYSICS	3	3	0	0	3
22.	1921501	Advanced Engineering Chemistry	CHEMISTRY	3	3	0	0	3
23.	1921502	Industrial Nanotechnology	CHEMISTRY	3	3	0	0	3

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OPEN ELECTIVE – II (VII SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	Course offering Department	CONTACT PERIODS	L	T	P	C
1.	1903706	Green Building Design	CIVIL	3	3	0	0	3
2.	1903716	Environmental and social impact assessment	CIVIL	3	3	0	0	3
3.	1904703	Tamil Computing	CSE	3	3	0	0	3
4.	1904010	Object Oriented Programming	CSE	3	3	0	0	3
5.	1904712	Software Engineering	CSE	3	3	0	0	3
6.	1905711	Electrical Circuits	EEE	3	3	0	0	3
7.	1905712	Renewable Energy systems	EEE	3	3	0	0	3
8.	1905713	Electric vehicles and power management	EEE	3	3	0	0	3
9.	1907001	Transducers Engineering	EIE	3	3	0	0	3
10.	1907003	Process Modeling and Simulation	EIE	3	3	0	0	3
11.	1907708	State Variable Analysis and Design	EIE	3	3	0	0	3
12.	1908003	Software Quality Management	IT	3	3	0	0	3
13.	1908004	C # and .Net Programming	IT	3	3	0	0	3
14.	1908005	Virtual Reality	IT	3	3	0	0	3
15.	1909718	Robotics	MECH	3	3	0	0	3
16.	1909719	Testing of Materials	MECH	3	3	0	0	3
17.	1909720	Design of Electric vehicles	MECH	3	3	0	0	3
18.	1910703	Clinical Trials	MEDICAL ELECTRONICS	3	3	0	0	3
19.	1910704	Regulatory requirements in pharmaceutical Industries	MEDICAL ELECTRONICS	3	3	0	0	3
20.	1910705	Microbiology	MEDICAL ELECTRONICS	3	3	0	0	3
21.	1920701	Analytical Methods and Instrumentation	PHYSICS	3	3	0	0	3
22.	1920702	Medical Physics	PHYSICS	3	3	0	0	3
23.	1920703	Electronic Materials	PHYSICS	3	3	0	0	3
24.	1921701	Waste Water Treatment	CHEMISTRY	3	3	0	0	3

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B.E. ELECTRONICS AND COMMUNICATION ENGINEERING											
S.NO.	**SUBJECT AREA**	**Credits per Semester**								**Credits Total**	**Percentage**
		I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**		
1.	HS	3	3		3					09	5.14%
2.	BS	12	12	4	4					32	18.29%
3.	ES	9	10							19	10.86%
4.	PC			19	16	16	16	14		81	46.29%
5.	PE					3	6		6	15	8.57%
6.	OE					3		3		06	3.43%
7.	EEC					1	2	3	6	12	6.86%
8.	PCD		1							01	0.57%
9.	Non Credit / Mandatory			✓							
	TOTAL	**24**	**26**	**23**	**23**	**23**	**24**	**20**	**12**	**175**	**100%**

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1919101 COMMUNICATIVE ENGLISH **L T P C**

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

OBJECTIVES:

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

UNIT I SHARING INFORMATION RELATED TO ONESELF/FAMILY & FRIENDS 9

Reading – short comprehension passages, practice in skimming-scanning and predicting – **Writing** – Blog/film review/quora/Twitter/Facebook– developing hints. **Listening** – short texts – short formal and informal conversations. **Speaking** – introducing oneself – exchanging personal information – **Language development** – Wh – Questions – asking and answering – yes or no questions – parts of speech. **Vocabulary development** – prefixes – suffixes – word formation: making sentences of your own.

UNIT II GENERAL READING AND FREE WRITING 9

Reading – Story with questions and answers – **Writing** – paragraph writing- topic sentence – main ideas – free writing, short narrative descriptions using some suggested vocabulary and structures – **Listening** – Listening to a speech – answering questions. **Speaking** – Presentation with PPT - **Language development** – prepositions, **Vocabulary development** – guessing meanings of words in contexts – articles.

UNIT III GRAMMAR AND LANGUAGE DEVELOPMENT 9

Reading – short texts (close reading) **Writing** – understanding text structure – use of reference words and discourse markers-coherence-jumbled sentences **Listening** – listening to stories to answer questions. **Speaking** – asking about routine actions and expressing opinions. **Language development** – Adjectives, degrees of comparison – conjunctions and connectives – **Vocabulary development** – single word substitutes-adverbs.

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UNIT IV READING AND LANGUAGE DEVELOPMENT 9

Reading – Newspaper articles- answering questions – **Writing** – letter writing, informal or personal letters – congratulating/ thanking/requesting help e-mails – forward a mail to Staff on given topic – **Listening** – listen to different sounds and differentiate the sounds with different words. **Speaking** – speaking about oneself- speaking about one‘s friend – **Language development** – Modals – Tenses – **Vocabulary development** – synonyms – antonyms – phrasal verbs.

UNIT V EXTENDED WRITING 9

Reading – longer texts – close reading – **Writing**– brainstorming -writing short essays – developing an outline – identifying main and subordinate ideas – dialogue writing – **Listening** – listening to talks- Note taking – **Speaking** – participating in conversations – short group conversations – **Language development** - correction of errors – **Vocabulary development** – collocations – fixed and semi-fixed expressions.

TOTAL: 45 PERIODS

OUTCOMES:

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

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

TEXT BOOKS:

1. Board of Editors. **“Using English –** A Course book for Under graduate Engineers and Technologists”, Orient BlackSwan Limited, Hyderabad, 2015.
2. Richards, C. Jack. **“Interchange Students’ Book-2”,** New Delhi, CUP, 2015.

REFERENCE BOOKS:

1. Bailey, Stephen. “Academic Writing: A practical guide for students”, New York: Rutledge, 2011.
2. Means, L. Thomas and Elaine Langlois, “English & Communication for Colleges”, Cengage Learning, USA, 2007.
3. Redston, Chris & Gillies, Cunningham Face2Face (Pre-intermediate Student‘s Book& Workbook) Cambridge University Press, New Delhi: 2005.
4. Comfort, Jeremy, et al. “Speaking Effectively: Developing Speaking Skills for Business English”, Cambridge University Press, Cambridge: Reprint 2011.

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5. Dutt P. Kiranmai and Rajeevan Geeta. “Basic Communication Skills, Foundation Books”, 2013.
6. Preliminary English Test – Cambridge University Press ESOL
7. Key English Test – Cambridge University Press ESOL.
8. Pronunciation Dictionary – Daniel Jones.

Course Outcomes	**PROGRAM OUTCOMES**												**Program Specific Outcomes**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	2	3	3	-	-	-	-	3	-	1	2	2	1	1
CO2	3	2	3	2	2	-	2	-	-	3	-	1	1	1	1	1
CO3	3	3	-	2	-	-	-	-	-	3	-	1	1	1	2	1
CO4	3	3	-	-	-	-	3	-	-	3	-	1	1	1	1	1
CO5	3	3	3	2	3	3	2	-	-	3	-	1	2	2	1	2

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1918102 ENGINEERING MATHEMATICS I

L T P C
3 1 0 4

OBJECTIVES:

- To understand and apply matrix techniques for engineering applications.
- To familiarize the student with basic calculus and traditions of traditional calculus.
- To solve the problems in single and multivariable calculus and plays an important role in science, economics, engineering.
- To acquaint the student with mathematical tools needed in evaluating integrals.
- To familiarize the student with multiple integrals and their usage in find the area and volume of two and three dimensional objects.

UNIT- I: MATRICES 9L+3T

System of equations – consistency and inconsistency- Eigen values and Eigen vectors of a real matrix - Characteristic equation - Properties of Eigen values and Eigen vectors - Statement and Applications of Cayley-Hamilton Theorem - Reduction of a quadratic form into canonical form by orthogonal transformation.

UNIT- II: DIFFERENTIAL CALCULUS FOR FUNCTIONS OF ONE VARIABLE 9L+3T

Limit of a function - Continuity – Differentiability - Differentiation rules – Rolle's Theorem and Mean Value theorem – Taylor's series- Maxima and Minima of functions of one variable.

UNIT- III: FUNCTIONS OF SEVERAL VARIABLES 9L+3T

Partial derivatives - Total derivatives - Jacobians and properties - Taylor's series for functions of two variables - Maxima and Minima of functions of two variables - Lagrange's method of undetermined multipliers.

UNIT- IV: INTEGRAL CALCULUS FOR FUNCTION OF ONE VARIABLE 9L+3T

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration by partial fractions - Improper integrals

UNIT- V: MULTIPLE INTEGRALS 9L+3T

Double integrals in Cartesian and polar coordinates - Change of order of integration – Area enclosed by plane curves - Change of variables in double integrals (Polar coordinates) – Triple integrals - Volume of solids.

TOTAL: 45L +15T PERIODS

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OUTCOMES:

- To apply the idea of reducing complex problems into simple form using matrix technique.
- Basic application of calculus in Engineering problems and to tackle for different geometries.
- This course equips the students to have basic knowledge and understanding of fundamental statistics to analyze and interpret data.
- To apply Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration by partial fractions in Engineering Problems.
- Basic application of Double and Triple integrals used in Engineering real life problems.

TEXT BOOKS:

1. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.
2. Veerarajan.T, “Engineering Mathematics”, McGrawHill Education(India) Private Ltd 2019.
3. Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", S.Chand Private Ltd.,11th Edition, 2005.

REFERENCE BOOKS:

1. Kreyszig Erwin, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016
2. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
3. 3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 7th Edition, New Delhi, 2015. [For Units I & III - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

Course Outcomes	**PROGRAM OUTCOMES**												**Program Specific Outcomes**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-

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1920103 ENGINEERING PHYSICS L T P C

(Common to all Branches of B.E. /B.Tech. Programmes) 3 0 0 3

OBJECTIVES:

- To understand the stress, strain and the concept of Hooke's law for the modulus of elasticity values .
- To facilitate the knowledge about basics of laser, optical fiber sources and transmission techniques.
- To enrich the idea of transfer and measurement of heat and uses of heat exchangers.
- To explore the basics of quantum theory and atomic and subatomic particles.
- To enhance the fundamental knowledge crystal Physics and its applications

UNIT-I: PROPERTIES OF MATTER 9

Elasticity – Hooke's law-Stress-strain diagram and its uses –Poisson ratio-factors affecting elastic modulus and tensile strength – twisting couple - torsion pendulum: theory and experiment (regular body) - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and ex

UNIT-II: LASERS AND FIBER OPTICS 9

Lasers: population of energy levels, Einstein's A and B coefficients derivation – resonant cavity, optical amplification (qualitative) – Nd-YAG laser-Semiconductor lasers: homojunction and heterojunction – Applications.

Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibres (material, refractive index, and mode) – losses associated with optical fibers–Fiber optic communication- fibre optic sensors: pressure and displacement- Endoscope.

UNIT-III: THERMAL PHYSICS 9

Transfer of heat energy – thermal conduction, convection and radiation – Newton's law cooling (qualitative) -heat conductions in solids – thermal conductivity - Forbe's and Lee's disc method: theory and experiment - conduction through compound media (series and parallel) – thermal insulation – applications: heat exchangers, refrigerators, ovens and solar water heaters.

UNIT-IV: QUANTUM PHYSICS 9

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

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UNIT-V: CRYSTAL PHYSICS 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course

- The students will gain knowledge on the basics of properties of matter and its applications,
- The students will acquire knowledge on the concepts of optical devices and their applications in fibre optics,
- the students will have adequate knowledge on the concepts of thermal properties of material and their applications in heat exchanger and electrical appliances,
- the students will get knowledge on advanced physics concepts of quantum theory and its applications in tunnelling microscopes, and
- the students will understand the basics of crystals, their structures and different crystal growth techniques.

TEXT BOOKS:

1. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press, 2015.
2. Gaur, R.K. & Gupta, S.L. “Engineering Physics”. Dhanpat Rai Publishers, 2012.
3. Pandey, B.K. &Chaturvedi, S. “Engineering Physics”. Cengage Learning India, 2012.
4. Brijlal and Subramanyam, “Properties of Matter”, S .Chand publishing, 2002.

REFERENCE BOOKS:

1. Halliday, D., Resnick, R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Serway, R.A. & Jewett, J.W. “Physics for Scientists and Engineers”. Cengage Learning, 2010.
3. Tipler, P.A. & Mosca, G. “Physics for Scientists and Engineers with Modern Physics’. W.H.Freeman, 2007.
4. Shatendra Sharma & Jyotsna Sharma, “Engineering Physics”. Pearson, 2018.

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1920103.1	3	1	1	-	-	1	1	-	-	-	-	1	2	-	-	-
1920103.2	3	1	1	-	1	1	1	-	-	-		1	3	-	-	-
1920103.3	3	-	1	-	-	1	-	-	-	-	-	1	3	-	-	-
1920103.4	3	1	-	1	-	1	1	-	-	-	-	1	3	1	-	-
1920103.5	3	1	-	1	-	-	1	-	-	-	-	1	2	-	-	-

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1921104 ENGINEERING CHEMISTRY L T P C
3 0 0 3

OBJECTIVES

- To make the students acquainted with boiler feed water requirements, related problems and domestic water treatment techniques.
- To understand the basic mechanism of surface phenomenon.
- To acquaint the student with the principles of electrochemical reactions, methods for corrosion prevention and protection of materials.
- To make the student conversant with the basics of polymers, cement and glass.
- To acquaint the students with the basics of nanomaterials, their properties and applications.

UNIT-I: WATER AND ITS TREATMENT 9

Hardness of water – types – expression of hardness – units - Boiler feed water-boiler troubles - scale and sludge, priming and foaming, caustic embrittlement, boiler corrosion. Treatment of boiler feed water – Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning). External treatment – Ion exchange process – domestic water treatment (break point chlorination) – Desalination of brackish water – Reverse Osmosis.

UNIT-II: SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: Types of adsorption – adsorption of gases on solids – adsorption of solute from solutions – adsorption isotherms. Freundlich's adsorption isotherm – Langmuir's adsorption isotherm – Contact theory. Kinetics of surface reactions, unimolecular reactions, Langmuir – applications of adsorption on pollution abatement. Catalysis: Catalyst – types of catalysis – Criteria – Autocatalysis – Catalytic poison and catalytic promoters – Acid base catalysis – Applications (3 way catalytic convertor) – Enzyme catalysis– Michaelis – Menten equation.

UNIT-III: ELECTROCHEMISTRY, CORROSION AND PROTECTIVE COATINGS 9

Electrochemical cell - redox reaction, electrode potential - origin of electrode potential - oxidation potential - reduction potential, measurement and applications - Electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion – causes – factors – types - chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control – material selection and design aspects – Electrochemical protection – sacrificial anode method and impressed current cathodic method. Protective coatings: Metallic coatings – Electroplating of Cu - electroless plating of Ni. Organic coatings: Paints - constituents and function.

UNIT-IV: ENGINEERING MATERIALS 9

Cement: Definition – classification of cement – Portland cement - manufacture and properties - setting and hardening of cement - special cement, water proof, white and sorel cement – properties and uses – Glass: Manufacture, types, properties and uses (laminated, safety and flint glass) - Polymers: Classification - types of polymerization - mechanism - methods of polymerization - Engineering polymers: Nylon-6, Nylon-6,6, Teflon, Kevlar and PEEK - preparation, properties and uses - Plastic and its types - Conducting polymers: Types and applications - Polymers in medicine and surgery (applications).

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UNIT-V: NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties (surface to volume ratio, melting point, optical and electrical). Nanoparticles, Nanocluster, Nanorods, Nanotube (CNT: SWNT and MWNT) and Nanowire, Synthesis - precipitation, thermolysis, hydrothermal, electrodeposition, chemical vapour deposition, laser ablation, sol-gel process and applications.

Total Periods: 45

OUTCOMES

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

- Gain idea about various methods available for water treatment.
- Explain the materials surface engineering.
- Understand the process of electrochemistry and its application to corrosion.
- Appreciate the nature and novelty of engineering materials.
- Ability to understand the nature and uses of nanomaterials.

TEXT BOOKS:

1. Shikha Agarwal, "Engineering Chemistry"-Fundamentals and Applications, Cambridge University Press, Delhi, 2015.
2. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2015.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCE BOOKS:

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. S.S. Dara and S.S. Umare, "A Text Book of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015.
3. B. Sivasankar, "Engineering Chemistry", Tata McGraw-Hill Publishing Company LTD, 2012.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	1	2	1	-	1	1	2	-	-	-	1	1	2	-	1	2
CO 2	2	1	1	-	1	1	-	-	-	-	-	1	-	-	1	-
CO 3	3	2	3	2	1	1	1	-	-	-	2	2	3	2	1	1
CO 4	2	1	1	1	1	1	-	-	-	-	-	2	-	-	1	-
CO 5	3	2	2	1	2	1	1	-	-	-	1	2	2	1	1	-

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1901006 **PROGRAMMING IN C** **L T P C**

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

OBJECTIVES:

- To develop C Programs using basic programming.
- To develop C programs using arrays and strings.
- To develop applications in C using functions.
- To develop C program using structures and union.

UNIT-I: BASICS OF C PROGRAMMING 9

Introduction to algorithm: Flowchart-Pseudo code- Introduction to programming paradigms – C programming: Data Types – Keywords – Variables and Constants – **Operators and Expressions:** Expressions – precedence – associativity – Input/Output statements – **Decision making and looping:** Branching statements, Iterative statements – Compilation process.

UNIT-II: ARRAYS AND STRINGS 9

Introduction to Arrays: **One dimensional array:** Assigning an array to another array – Equating an array with another array –**Two dimensional Arrays:** Declaration – usage of two dimensional array – reading, storing and accessing elements in two dimensional array –memory representation – **String operations:** String library functions – list of strings-command line arguments.

UNIT-III: FUNCTIONS 9

Introduction to functions: Classification of functions – function definition – function call – function with inputs and outputs – recursive function – library functions-scope of variables.

UNIT-IV: STRUCTURES AND UNIONS 9

Introduction to Structures: Array of structures – Nested structure-functions and Structures **Introduction to union**: Practical applications of union – typedef and structures – enumerated data type.

UNIT-V: STORAGE CLASS AND PREPROCESSOR DIRECTIVE 9

Introduction to storage classes: Types of storage classes – **C preprocessor Directives**: Types of preprocessor directives – Pragma Directive-conditional directive.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop simple applications in C using basic constructs.
- Design and implement applications using arrays and strings
- Develop and implement applications in C using functions
- Develop applications in C using structures and unions
- Design applications using preprocessor to stimulate functions

TEXT BOOKS:

1. Anita Goel and Ajay Mittal, – **“Computer Fundamentals and Programming in C”**, Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Reema Thareja, – **“Programming in C”**, Oxford University Press, Second Edition, 2016.

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel – **“C How to Program”**, Seventh Edition, Pearson Publication.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	3	-	2	-	-	-	-	-	-	1	-	2	-	-
CO 2	3	3	-	-	2	-	1	-	-	-	-	-	3	-	-	-
CO 3	2	1	-	2	3	-	-	-	-	-	-	-	-	-	2	-
CO 4	-	-	2	-	-	-	-	-	2	-	1	-	-	1	-	-
CO 5	-	3		-	-	1	-	-	2	-	-	-	-	-	-	3

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1901007	ENGINEERING GRAPHICS	L	T	P	C
		2	0	4	4

OBJECTIVES:

The main learning objective of this course is to impart knowledge

1. To draw the conics curves and special curves.
2. To draw the orthographic projection of lines and plane surfaces.
3. To draw the projections and solids and Isometric projection of simple solids.
4. To draw projections of Section of Solids and development of surfaces.
5. To draw free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

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

UNIT-I: PLANE CURVES AND SPECIAL CURVES 10

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid (Rolling Circle rolls on flat surface only). Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

UNIT-II: PROJECTION OF POINTS, LINES AND PLANE SURFACES 16

Orthographic projection- Principles-Principal planes - First angle projection- projection of points at First Quadrant only. 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. Projection of planes (polygonal and circular surfaces) which inclined to both the principal planes by rotating object method.

UNIT-III PROJECTION OF SOLIDS AND ISOMETRIC PROJECTION 16

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is Inclined to one of the principal planes by rotating object method. Principles of isometric projection – isometric scale – Isometric projections of simple solids - Prisms, pyramids, cylinders, cones.

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UNIT-IV: PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 16

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

UNIT-V: FREE HAND SKETCHING AND PERSPECTIVE PROJECTIONS 16

Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views from pictorial views of objects. Perspective projection of simple solids-Prisms and pyramids by visual ray method.

TOTAL : 75 PERIODS

COURSE OUTCOMES:

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

- To draw the conics curves and special curves.
- To draw the orthographic projection of lines and plane surfaces.
- To draw the projections and solids and Isometric projection of simple solids.
- To draw projections of Section of Solids and development of surfaces.
- To draw free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids.

TEXTBOOKS:

1. N.D.BHATT, "Engineering Drawing (Plane and Solid Geometry)", Charotar Publishing House PVT. LTD. 53rd Edition : 2018 (Reprint)

2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2019.

REFERENCE BOOKS:

1. T.Jeyapoovan “Engineering Graphics Using Auto CAD”, Vikas Publishing House Pvt. LTD, seventh Edition, 2015.
2. Luzzader, Warren.J. and Duff, John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition,

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2011.

4. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.
5. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1
2	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1
3	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1
4	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1
5	2	-	3	-	-	-	-	-	1	3	-	1	2	1	1	1

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1901108 PHYSICS AND CHEMISTRY LABORATORY **L T P C**

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

PHYSICS LABORATORY

OBJECTIVES:

- To study the behaviour of material under shear stress.
- To learn the basics concept understanding the deformation due to linear stress
- To explore the photons to measure the physical parameters.
- To introduce experiments to test thermal conductivity of bad conductor.
- To study the spectrum of white light.

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Determination of rigidity modulus – Torsion pendulum.
2. Determination of Young's modulus by non-uniform bending method.
3. (a) Determination of wavelength and particle size using Laser.
   (b) Determination of acceptance angle and numerical aperture in an optical Fiber.
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of velocity of sound and compressibility of liquid and Solid – Ultrasonic Interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of thickness of a thin wire – Air wedge method

TOTAL: 30 PERIODS

OUTCOMES:

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

- Measure the rigidity modulus of the material.
- Calculate the deformation due to linear stress and Young's Modulus
- Use laser to measure the physical parameters.
- Calculate the thermal conductivity of bad conductor by lees disc.
- Measure the wavelength of the mercury the spectrum.

REFERENCE BOOKS:

1. Wilson J.D. and Hernaandez Hall C.A. – **"Physics Laboratory Experiments",** Houghton Mifflin Company, New York, 2005.
2. S. Srinivasan, **"A Text Book of Practical Physics",** S. Sultan Chand publications. 2005
3. R. Sasikumar, **"Practical Physics",** PHI Learning Pvt. Ltd, New Delhi, 2011.

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CO	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	1	-	1	-	1	1	-	-	-	1	-	-	-
2	3	1	1	1	-	1	-	1	1	-	-	-	1	-	-	-
3	3	1	1	1	-	2	-	1	1	-	-	-	2	-	-	-
4	3	1	1	1	-	1	-	1	1	-	-	-	2	-	-	-
5	3	1	1	1	-	1	-	1	1	-	-	-	1	-	-	-

CHEMISTRY LABORATORY

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by viscometery.
- To make the student conversant with the corrosion defects experimentally.
- To develop and understand the basic concepts of acidic and basic nature using pH.
- To make the student familiar with the properties and nature of alloys experimentally.

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Estimation of HCl using Na_2CO_3 as primary standard and determination of alkalinity in water sample.
2. Estimation of copper content of the given solution by iodometry.
3. Determination of strength of given hydrochloric acid using pH meter.
4. Determination of strength of acids in a mixture of acids using conductivity meter.
5. Estimation of iron content of the given solution using potentiometer.
6. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
7. Pseudo first order kinetics-ester hydrolysis.
8. Corrosion experiment-weight loss method.
9. Conductometric titration of strong acid Vs strong base.

TOTAL: 30 PERIODS

OUTCOMES:

The students should be able to:

- Obtain the hands-on knowledge in the quantitative chemical analysis of water quality related parameters.
- Understand the experimental concepts in the mixture of acids and bases.
- Appreciate the need of iodometry in the estimation of metals.
- Explore the drawbacks of corrosion by weight loss method.

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- Design and carry out the scientific experiments related to boiler troubles.

TEXTBOOKS:

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

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	2	2	1	2	-	1	2	-	-	-	-	1	-	-	2	-
CO 2	3	2	2	2	-	1	2	-	-	-	-	1	3	-	1	-
CO 3	2	2	1	2	-	1	2	-	-	-	-	1	2	1	1	-
CO 4	3	2	3	2	-	1	2	-	-	-	-	1	2	3	1	-
CO 5	2	2	1	2	-	1	2	-	-	-	-	1	2	-	1	-

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1901010	C PROGRAMMING LABORATORY (Common to all branches of B.E. / B.Tech. Programmes)	L T P C 0 0 4 2

OBJECTIVES:

- To develop programs in C using basic constructs.
- To develop applications in C using arrays and functions.
- To develop applications in C using Strings and Structures.

LIST OF PROGRAMS:

1. Programs using I/O statements and expressions.
2. Programs using decision-making constructs.
3. Write a program to find whether the given year is leap year or Not? (Hint: not every centurion year is a leap. For example 1700, 1800 and 1900 is not a leap year)
4. Write a program to perform the Calculator operations, namely, addition, subtraction, multiplication, division and square of a number.
5. Check whether a given number is Armstrong number or not?
6. Check whether a given number is odd or even?
7. Write a program to perform factorial of a number.
8. Write a C program to find out the average of 4 integers.
9. Show how to display array elements using two dimensional array.
10. Write a C program to perform swapping using function.
11. Display all prime numbers between two intervals using functions.
12. Reverse a sentence using recursion.
13. Write a program in C to get the largest element of an array using the function.
14. Write a C program to concatenate two string.
15. Write a C program to find the length of String.
16. Find the frequency of a character in a string.
17. Write a C program to Store Student Information in Structure and Display it.
18. The annual examination is conducted for 10 students for five subjects. Write a program to read the data and determine the following:
    a) Total marks obtained by each student.
    b) The highest marks in each subject and the marks of the student who secured it.
    c) The student who obtained the highest total marks.

TOTAL: 60 PERIODS

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OUTCOMES:

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

- Develop C programs for simple applications making use of basic constructs, arrays and strings.
- Develop C programs involving functions, recursion, pointers, and structures.
- Design applications using sequential and random access file processing.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	3	-	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	-	-	-	-	2	-	-	-	-	1	-	-	-	-	2	-
CO 3	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	2
CO 4	-	2	-	-	-	2	-	-	-	-	2	-	-	2	-	-
CO 5	-	-	-	-	-	-	-	3	-	-	-	1	2	-	-	-

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1919201 **TECHNICAL ENGLISH** **L T P C**

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

OBJECTIVES:

The Course prepares Second semester Engineering & Technology students to:

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

UNIT-I: INTRODUCTION / TECHNICAL ENGLISH 9

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

UNIT- II: READING AND STUDY SKILLS 9

Listening – Listening to a technical conversation and filling the gaps – **Speaking** – describing a process – **Reading** – reading longer technical texts- identifying the various transitions in a text- paragraphing – Writing – interpreting charts, graphs – **Vocabulary Development** – vocabulary used in formal letters/emails and reports **Language Development** – impersonal passive voice, numerical adjectives.

UNIT- III: TECHNICAL WRITING AND GRAMMAR 9

Listening – Listening to classroom lectures/ talks on engineering/technology – **Speaking** – mechanics of presentations – **Reading** – longer texts both general and technical, practice in speed reading; **Writing** – Describing a process, use of sequence words – **Vocabulary Development** – Misspelt words. **Language Development** – homonyms.

UNIT- IV: REPORT WRITING 9

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Listening – Listening to documentaries and making notes. **Speaking** – introduction to technical presentations – **Reading** – reading for detailed comprehension – **Writing** – Product description – job application – cover letter – Résumé preparation (via email and hard copy)- Issue based essays and official circulars – **Vocabulary Development** – finding suitable synonyms – paraphrasing – **Language Development** – clauses – if conditionals.

UNIT- V: GROUP DISCUSSION AND JOB APPLICATIONS 9

Listening – TED/INK talks, answering the questions; **Speaking** – participating in a group discussion – **Reading** – reading and understanding technical articles. **Writing** – Writing reports – minutes of a meeting – Letter Writing- Letter to the Editor – Letter seeking permission for an Industrial visit/ Internship – Business Letters, asking for quotation/clarification – seeking orders, thanking for the order given, Complaint letters – **Vocabulary Development** – **verbal analogies Language Development** – reported speech.

TOTAL: 45 PERIODS

OUTCOMES:

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

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	2	-	-	-	-	-	-	-	3	-	1	2	2	1	2
CO 2	3	2	2	-	-	-	-	-	-	-	-	2	1	1	1	1
CO 3	3	-	-	-	-	-	-	-	3	3	-	1	1	2	2	2
CO 4	3	2	2	2	-	-	-	-	-	3	-	1	1	1	1	1
CO 5	3	2	-	2	-	-	-	-	-	3	2	1	2	1	1	2

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1918202 ENGINEERING MATHEMATICS II

L T P C

3 1 0 4

OBJECTIVES :

- This course is designed to cover topics such as Ordinary Differential equation, Vector Calculus, Complex Analysis and Laplace Transform.
- ODE is the powerful tools to solve practical problems in the field of engineering.
- Vector calculus can be widely used for modeling the various laws of physics.
- The various methods of complex analysis helps us to evaluate contour integration.
- Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering.

UNIT-I: ORDINARY DIFFERENTIAL EQUATIONS 9L+3T

First order linear differential equations- Exact differential equations- Second order linear differential equations with constant coefficients – Method of variation of parameters – Homogenous equation of Euler's and Legendre's type.

UNIT-II: VECTOR CALCULUS 9L+3T

Gradient and directional derivative – Divergence and curl– Irrotational and Solenoidal vector fields – Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT-III: LAPLACE TRANSFORMS 9L+3T

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

UNIT-IV: ANALYTIC FUNCTIONS 9L+3T

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

UNIT-V: COMPLEX INTEGRATION 9L+3T

Complex integrationl – 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.

TOTAL: 45L +15T PERIODS

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OUTCOMES:

- Apply complex variables in finding, Gradient, divergence, curl of a vector point function.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
- Analytic functions, conformal mapping and complex integration are evaluated.
- Laplace transform and inverse transform of simple functions, properties, are studied.
- Apply various techniques in solving Ordinary differential equations with constant coefficients.

TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi,43rd Edition, 2014.
2. Veerarajan. T, "Engineering Mathematics", McGrawHill Education(India) Private Limited 2019.

REFERENCE BOOKS:

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

CO - PO and CO - PSO MAPPING:

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	3	1	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
CO5	3	1	1	1	-	-	-	-	-	-	-	1	-	-	-	-

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1920203 PHYSICS FOR ELECTRONICS ENGINEERING L T P C

(Common to EEE, ECE, EIE & Medical Electronics) 3 0 0 3

OBJECTIVES:

- To understand the concept of conductivities in the conducting material .
- To facilitate the knowledge about basics of doping, types of semiconductors.
- To enrich the idea of magnetism and dielectric properties.
- To explore the basics of interaction of photon with materials.
- To enhance the fundamental knowledge nano materials and its applications.

UNIT- I: ELECTRICAL PROPERTIES OF MATERIALS 9

Classical free electron theory - Expression for electrical conductivity and Thermal conductivity - Wiedemann-Franz law - Success and failures – Quantum Free electron theory – Fermi Distribution function – Density of energy states –Energy bands in solids; conductors, semiconductors and insulators.

UNIT- II: SEMICONDUCTOR PHYSICS 9

Direct and indirect semiconductors - Intrinsic Semiconductors –Carrier concentration in intrinsic semiconductors – Extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors – Carrier transport– Drift and Diffusion transport – Hall effect - Theory and Experiment – Applications.

UNIT- III: MAGNETIC AND DIELECTRIC PROPERTIES OF MATERIALS 9

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

UNIT- IV: OPTICAL PROPERTIES OF MATERIALS 9

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

UNIT- V: NANOELECTRONIC DEVICES 9

Introduction - Size dependence of Fermi energy– quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures – quantum interference effects – Coulomb blockade effects - Single electron phenomena and Single electron Transistor - quantum dot laser – magnetic semiconductors– spintronics - Carbon nanotubes: Properties and applications.

TOTAL: 45 PERIODS

OUTCOMES:

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

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

TEXT BOOKS:

1. Kasap, S.O. “Principles of Electronic Materials and Devices”, McGraw-Hill Education, 2007.
2. Umesh K Mishra & Jasprit Singh, “Semiconductor Device Physics and Design”, Springer, 2008.
3. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”, Narosa Publishing House, 2009.
4. Kittel, C. , “Introduction to Solid State Physics”, Wiley, 2005.

REFERENCE BOOKS:

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

CO - PO and CO - PSO MAPPING:

CO	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	-	1	1	1	-	-	-	-	-	3	-	-	-
2	3	2	2	-	-	1	1	-	-	-	-	-	3	1	-	-
3	3	2	2	-	-	1	1	-	-	-	-	-	1	-	-	-
4	3	2	2	-	-	1	1	-	-	-	-	-	2	-	-	-
5	3	2	2	-	1	1	1	-	-	-	-	-	3	1	-	-

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1921203 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES

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

UNIT-I: ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 14

Definition, scope and importance of environment – need for public awareness – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the grassland ecosystem, aquatic ecosystems (lakes, oceans) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – 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 an ecosystems.

UNIT-II: ENVIRONMENTAL POLLUTION 8

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

UNIT-III: NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, soil erosion and desertification, 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– 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– 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.

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UNIT-IV: SOCIAL ISSUES AND THE ENVIRONMENT 7

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

UNIT-V: HUMAN POPULATION AND THE ENVIRONMENT 6

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

Total Periods: 45

OUTCOMES

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

- Gain knowledge on ecosystem, environment and biodiversity.
- Understand the process and disadvantages of environmental pollution.
- Analyze the ill effects of over exploitation of natural resources.
- Explain the social issues from unsustainable to sustainable development.
- Outline the need for decrease in population growth and its measures.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	3	2	-	2	-	2	1	2	-	-	-	2	-	3	1	-
CO 2	2	2	-	2	-	1	1	2	-	-	1	2	2	2	1	1
CO 3	2	1	-	1	-	1	1	1	-	-	-	1	-	2	-	1
CO 4	2	2	-	2	-	1	3	2	-	-	1	3	2	1	1	2
CO 5	3	2	-	2	-	2	3	2	-	-	-	2	-	1	1	-

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1901005 PROBLEM SOLVING AND PYTHON PROGRAMMING

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

L	T	P	C
3	0	0	3

OBJECTIVES:

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

UNIT- I: ALGORITHMIC PROBLEM SOLVING, DATA TYPES 9

Algorithms: building blocks of algorithms (statements, control flow, functions), notation (pseudo code, flow chart). Python interpreter and interactive mode; **values and types:** int, float, Boolean, string, and list; variables, operators and expressions, statements, tuple assignment, precedence of operators, comments, Illustrative programs: Algorithm for Arithmetic expression (addition and subtraction).

UNIT- II: CONTROL FLOW STATEMENTS AND FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); **Iteration:** state, while, for, break, continue, pass; functions, function definition and use. **Fruitful functions:** return values, parameters, local and global scope, recursion. Illustrative programs: exchange the values of two variables square root, printing n numbers iteratively

UNIT- III: LIST& TUPLES 9

Lists: list operations, list slices, list methods, list loop, mutability, list parameters; **Tuples:** tuple assignment, tuple as return value. Comparison of Lists and tuples. Illustrative programs: selection sort, insertion sort, Quick sort.

UNIT- IV: STRINGS, DICTIONARIES & SET 9

Strings: string slices, immutability, string functions and methods, string module. **Dictionaries:** Operations (create, access, add, remove) and methods. (insert, delete).Set operation (Access, Add, Remove).Comparison of dictionary and set.

UNIT- V: FILES, MODULES & PACKAGES 9

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

TOTAL: 45 PERIODS

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OUTCOMES:

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

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

TEXT BOOKS:

1. Reema Thareja, **"Python Programming using Problem solving Approach"** ,Oxford Higher Education,2017

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

REFERENCE BOOKS:

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

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CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	2	3	-	-	-	1	-	-	-	-	2	2	-	-	3
CO 2	-	-	-	-	2	-	-	-	-	-	-	-	-	2	3	-
CO 3	-	-	-	2	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	-	-	-	-	2	2	-	-	-	2	-	-	-	2	-	-
CO 5	-	-	-	-	-	-	-	-	-	2	2	-	-	-	1	-

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1901008 **BASIC CIVIL AND MECHANICAL ENGINEERING** **L T P C**

(Common to CSE, EEE, ECE, EIE, IT & Medical Electronics) **3 0 0 3**

OBJECTIVES:

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

<u>A – OVER VIEW</u>

UNIT- I: SCOPE OF CIVIL AND MECHANICAL ENGINEERING 7

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

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

<u>B – CIVIL ENGINEERING</u>

UNIT- II: SURVEYING AND CIVIL ENGINEERING MATERIALS 7

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

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

UNIT- III: BUILDING COMPONENTS AND STRUCTURES 11

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

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

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C – MECHANICAL ENGINEERING

UNIT- IV: INTERNAL COMBUSTION ENGINES AND POWER PLANTS 11

Classification of Power Plants - Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines.

Working principle of steam, Gas, Diesel, Hydro – electric and Nuclear Power plants – working principle of Cochran, La-mont, Benson Boilers, Turbines, Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps

UNIT- V: REFRIGERATION AND AIR CONDITIONING SYSTEM 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

- Knowledge of basics in various sub-disciplines of civil and mechanical engineering.
- Use the basics of surveying for calculation of area and volume in basic construction works
- Fundamental elements of civil engineering structures and construction methods.
- Understand the energy sources and working principle of power plants and apply the knowledge of power plants to diagonize and solve the Engineering problem and the working principle of IC Engines
- Understand the function of refrigeration and air conditioning system.

TEXT BOOKS:

1. Shanmugam G and Palanichamy MS, **“Basic Civil and Mechanical Engineering”**, Tata McGraw Hill Publishing Co., New Delhi, 2018.
2. Satheesh Gopi, **“Basic Civil Engineering”**, Pearson publications, 2009.
3. Basant Agrawal and C.M.Agrawal, **“Basic Mechanical Engineering”**, Wiley Publications Pvt Ltd., New Delhi, 2018.

REFERENCE BOOKS:

1. Ramamrutham S., **“Basic Civil Engineering”**, Dhanpat Rai Publishing Co.(P) Ltd, 2015.
2. Rajput R.K., **“Thermal Engineering”**, Laxmi Publications (P) Ltd, 10th Edition, 2018.
3. Kothandaraman C.P., Domkundwar S., Dhanpat Rai, **“Thermal Engineering”**, Publishing Co.(P) Ltd., 6th Edition, 2015.

CO - PO and CO - PSO MAPPING:

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	1	2	-	-	3	2	1	-	-	-	1	1	-	1	2
CO 2	3	3	2	1	-	1	-	-	-	-	-	-	2	1	-	2
CO 3	3	1	2	1	-	1	1	-	-	-	-	-	2	1	-	2
CO 4	3	2	2	1	-	1	-	-	-	-	-	1	2	1	1	2
CO 5	3	2	2	1	-	-	-	-	-	-	-	-	1	-	-	1

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1901009 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

	L	T	P	C
	0	0	4	2

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

OBJECTIVES:

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

LIST OF PROGRAMS:

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. How to create, slice, change, delete and index elements using Tuple.
8. Find First n prime numbers
9. How to create, slice, change,add,delete and index elements using list.
10. Write a program to calculate the length of a string.
11. Write a program to reverse the string
12. How to change, delete, add and remove elements in Dictionary
13. Find the most frequent words in a text read from a file
14. Simulate elliptical orbits in Pygame
15. Simulate bouncing ball using Pygame

TOTAL: 60 PERIODS

PLATFORM NEEDED:

Python 3 interpreter for Windows/Linux

OUTCOMES:

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

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

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	-	-	-	-	-	1	-	-	-	3	2	3	-	-
CO 2	-	2	2	-	-	2	-	-	-	-	2	-	-	3	-	-
CO 3	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-
CO 4	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	-
CO 5	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	3

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1901208 **ENGINEERING PRACTICES LABORATORY** **L T P C**

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

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools.
- To gain the skills for making fitting joints and assembling air conditioner.
- To develop the skills for making simple electrical wiring connections using suitable tools.
- To provide hands on experience for soldering and gain knowledge about the behavior of electronics components.

<u>GROUP A (CIVIL & MECHANICAL)</u>

I CIVIL ENGINEERING PRACTICE **15**

Buildings:

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

Plumbing Works:

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

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

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

Carpentry Works:

a) Study of the joints in roofs, doors, windows and furniture.
b) Hands-on-exercise:

Wood work, joints by sawing, planning and cutting.

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II MECHANICAL ENGINEERING PRACTICE 15

Welding:

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

b) Gas welding practice

Basic Machining:

a) Simple Turning and Taper turning

b) Drilling Practice

Sheet Metal Work:

a) Forming & Bending

b) Model making – Trays and funnels.

c) Different type of joints.

Fitting:

a) Preparation of square fitting

b) Preparation of V – fitting models.

Machine assembly practice:

a) Assembly of centrifugal pump

b) Assembly of air conditioner

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

b) Foundry operations like mould preparation for gear and step cone pulley.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 15

1. Residential house wiring using Switches, Fuse, Indicator, Lamp and Energy meter.
2. Fluorescent Lamp Wiring.
3. Staircase Wiring.
4. Measurement of Voltage, Current, Power and Power factor in electrical circuit.
5. Measurement of Energy using Analog & Digital Energy meter.
6. Measurement of Earth Resistance.
7. Study of Industrial house wiring.
8. Identification & Study of protective devices: Fuses & Fuse carriers, MCB, ELCB and Isolators with ratings and usage.

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IV ELECTRONICS ENGINEERING PRACTICE 15

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

TOTAL: 60 PERIODS

OUTCOMES:

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

- Fabricate carpentry components and pipe connections including plumbing works.
- Use welding equipment to join the structures.
- Carry out the basic machining operations
- Make the models using sheet metalwork's
- Illustrate on centrifugal pump, Air conditioner, operations of smithy, foundry and fittings
- Carry out basic home electrical works and appliances
- Measure the electrical quantities
- Elaborate on the components, gates, soldering practices.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1.	Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexiblepipes, couplings, unions, elbows, plugs and other fittings.	15 Sets
2.	Carpentry vice (fitted to work bench)	15 Nos.
3.	Standard woodworking tools	15 Sets
4.	Models of industrial trusses, door joints, furniture joints	5 each

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MECHANICAL

1.	Arc welding transformer with cables and holders	5 Nos.
2.	Welding booth with exhaust facility	5 Nos.
3.	Welding accessories like welding shield, chipping hammer,wire brush	5 Sets
4.	Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5.	Centre lathe	2 Nos.
6.	Hearth furnace, anvil and smithy tools	2 Sets
7.	Moulding table, foundry tools	2 Sets
8.	Power Tool: Angle Grinder	2 Nos.
9.	Study-purpose items: centrifugal pump, air-conditioner	One each
10.	Fitting tools, Hack saw frame, 12' file, hack saw blade	15 Nos.

ELECTRICAL

1.	Assorted electrical components for house wiring	15 Sets
2.	Fluorescent Lamp	15 Sets
3.	Electrical measuring instruments	10 Sets
4.	Analog & Digital energy meter	5 Sets
5.	Megger	2

ELECTRONICS

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

Course Outcomes	PROGRAM OUTCOMES											
	1	2	3	4	5	6	7	8	9	10	11	12
CO 1	3	-	-	-	-	1	-	-	-	-	-	1
CO 2	-	1	2	-	3	-	-	-	-	-	1	-
CO 3	-	-	-	3	2	-	-	-	-	-	-	1
CO 4	-	2	3	1	2	-	-	-	-	-	-	-
CO 5	-	3	2	2	-	-	-	-	1	-	-	-

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1901209 APPLIED PHYSICS AND ENVIRONMENTAL CHEMISTRY LABORATORY

L	T	P	C
0	0	4	2

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

(Laboratory classes on alternate weeks for Physics and Environmental Chemistry)

APPLIED PHYSICS LABORATORY

OBJECTIVES:

- To measure the band gap of given semi conductor.
- To study I-V characteristics of solar cell
- To measure electrical resistivity of metal and alloy
- To calculate the hkl planes
- To measure the paramagnetic susceptibility by Quinke's method.

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Determination of band gap of a semiconductor.
2. Study of I-V characteristics of solar cell and determination of its efficiency.
3. Determination of electrical resistivity of metal and alloy –Carey foster Bridge.
4. Calculation of lattice cell parameter – X-ray diffraction method.
5. Measurement of susceptibility of paramagnetic solution by Quinke's method.
6. Study of magnetic Hysteresis-B-H curve.
7. Measurement of Temperature using LM35.

TOTAL: 30 PERIODS

DEMO:

1. Crystal growth- Low temperature solution growth.
2. Absorption and transmittance measurement of materials – UV visible spectrum.
3. Attenuation losses in optical Fiber.

OUTCOMES:

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

- Measure the band gap of semiconductors
- Measure the efficiency of solar cell
- Compare the resistivity of metals and alloys
- Calculate the lattice parameter and interplanar distance.
- Understand the susceptibility values for any paramagnetic substances.

`

REFERENCE BOOKS:

1. Wilson J.D. and Hernaandez Hall C.A., “Physics Laboratory Experiments”, Houghton Mifflin Company, New York, 2005.
2. S. Srinivasan, “A Text Book of Practical Physics”, S. Sultan Chand publications. 2005.
3. R. Sasikumar, “Practical Physics”, PHI Learning Pvt. Ltd, New Delhi, 2011.

CO - PO and CO - PSO MAPPING:

CO	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	2	2	-	1	-	1	1	-	-	-	2	-	-	-
2	3	2	2	2	-	1	-	1	1	-	-	-	2	-	-	-
3	3	2	2	1	-	-	-	1	1	-	-	-	2	-	-	-
4	3	1	2	2	-	1	-	1	1	-	-	-	1	-	-	-
5	3	2	2	2	-	2	-	1	1	-	-	-	3	1	-	-

ENVIRONMENTAL CHEMISTRY LABORATORY

OBJECTIVES:

- To determine the dissolved oxygen and chloride content in water.
- To determine calcium and magnesium present in domestic water.
- To estimate iron, sodium and chlorine using various techniques.
- To determine the chemical oxygen demand in industrial effluent.
- To determine the available chlorine in bleaching powder.

LIST OF EXPERIMENTS: (Any 5 Experiments)

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of DO content of water sample by Winkler’s method.
3. Determination of chloride content of water sample by argentometric method.
4. Estimation of iron content of the water sample using spectrophotometer
5. Determination of COD value of industrial effluents
6. Estimation of sodium by flame photometry
7. Estimation of available chlorine in bleaching powder

TOTAL: 30 PERIODS

DEMO:

1. Pollution abatement by adsorption techniques
2. Scintillation Process

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OUTCOMES:

- Appreciate the basic requirements for potable water.
- Understand the need of dissolved oxygen in water.
- Explore the quantity of bleaching powder to be added in water.
- Analyze the ill effects caused by the industrial effluents.
- Explore new research areas in the treatment of waste water.

TEXTBOOKS:

Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014).

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	1	1	2	-	1	1	-	-	-	-	1	-	1	-	1
CO 2	3	2	2	1	-	2	1	-	-	-	-	1	2	-	1	-
CO 3	3	2	2	1	-	1	2	-	-	-	-	1	-	-	1	-
CO 4	2	3	3	2	-	2	3	-	-	-	-	1	2	-	1	-
CO 5	3	3	3	2	-	3	2	-	-	-	-	1	2	-	1	-

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1901200 – NSS/NCC/YRC/NSO

Unit – 1 : NATIONAL SERVICE SCHEME (NSS) **L T P C**

0 0 2 1

COURSE OBJECTIVES :

The main objectives of this course are:

- To help learners know about NSS in the context of youth, community and voluntary service.
- To teach the importance of health, hygiene and sanitation for a healthy Nation.
- To understand the community in which they work.
- To identify the problems of the community and involve them in problem-solving.
- To develop the capacity to meet emergencies and natural disasters.
- To practice the National integration and social harmony.
- To utilize their knowledge in finding practical solutions to individual and community

MODULE - I : INTRODUCTION AND BASIC CONCEPTS OF NSS 8

History – Aim – Objectives of NSS- Emblem – Motto – Badge – Song - Organizational structure - Roles and Responsibilities of NSS-Regular activities - Any approved indoor / outdoor programs approved by the Principal

MODULE - II :YOUTH LEADERSHIP, SOCIAL HARMONY AND NATIONAL INTEGRATION 8

Meaning and types of Leadership - Qualities of good leaders and leadership - Importance and role of youth leadership - Role of youth in peace and Nation building - Any approved indoor / outdoor programs approved by the Principal

MODULE - III : HEALTH, HYGIENE AND SANITATION AND YOUTH HEALTH 8

Definition, Needs and Scope of Health Education - Swachh Bharat Abhiyan - Healthy Lifestyles HIV, AIDS, Drugs abuse - Any approved indoor / outdoor programs approved by the Principal

MODULE - IV :ENVIRONMENT ISSUES, EMERGENCIES AND DISASTER MANAGEMENT 8

Environment conservation, enrichment and sustainability - Waste management - Natural resource management [Rain water harvesting and Energy conservation] - Introduction to Disaster Management, Classification of Disasters - Any approved indoor / outdoor programs approved by the Principal

MODULE - V SPECIAL CAMPING AND YOUTH DEVELOPMENT PROGRAMMES 8

Aim and objectives of special camping - Organization of special camping - National Youth Policy - Youth Development - Any approved indoor / outdoor programs approved by the Principal

TOTAL PERIODS : 40

COURSE OUTCOMES :

Learners will have the knowledge about NSS and its role in the fields of health, hygiene, emergencies & natural disasters and involve them in problem-solving of the nearest community so as to build a strong country.

REFERENCES :

1. National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi.
2. National Youth Policy, Government of India, Ministry of Youth Affairs and Sports,

New Delhi.

3. https://nss.gov.in/
4. National Service Scheme Handbook, Anna University, Chennai - 25.

Unit – 2 : NATIONAL CADETS CORPS (NCC) **L T P C**
0 0 2 1

OBJECTIVES:

- To develop the students character into comradeship
- To improve the self-responsibilities of the student
- To give the secular outlook
- To perform the adventure activates
- To give the ideas of selfless service among young citizens

MODULE I INTRODUCTION NCC **8**

Moto of NCC- Cardinal principals of Discipline - Aim of NCC – History of NCC – NCC Organization- NCC Song - Opportunities in Indian Army

MODULE II BASIC DRILL PRACTICE **8**

Foot Drill – Arms Drill – Ceremonial Drill – Attention – Right Face – Salute – Present Arms and Orders – Forward March.

MODULE III NCC ARMY **8**

Armed Forces – Military History – Badges and Ranks- Setting a Map, Finding Own Position and North– General Awareness – Border & Coastal Areas

MODULE IV NCC NAVY **8**

History of Indian Navy – Types of Warship and Roles – Navy Ranks – Role of INDO PAK war – 1971 & Kargil war – Naval Communications

MODULE V NCC SAFETY AND RESCUE OPERATIONS **8**

First Aid – Firefighting – Flooding – Damage Control - Health and Hygiene – Swimming - Trekking

Total Periods: 40

OUTCOMES:

- The NCC cadets learnt several Valuable things Selfness, Honesty Hard work and discipline
- NCC develops their personalities in different angles
- NCC army grows the turnout cadets in Army
- NCC Navy intensification the technical information about the coastal areas
- NCC generally improve the personal and social impact
- NCC is foot path to join in an Indian defense

Text books:

1. R Gupta's "NCC Navy wing" it covers both Common and Special Subjects
2. R Gupta's "Handbook of National Cadets Corps for 'A', 'B' and 'C' certificate examination"
3. NCC Army Hand book
https://nccorissa.org/old/Doc/cadet%20Hand%20Book%20SPL%20SUBJECT%20Army.pdf
4. NCC Navy Hand Book
https://dokumen.tips/documents/ncc-cadet-handbook-navy-specialised-subject-sd-swpdf-ncc-cadet-handbook.html.

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Unit -3 : YOUTH RED CROSS (YRC)

L T P C
0 0 2 1

OBJECTIVES: To inculcate the following in the youth of our college

- Health awareness
- Civic responsibilities with humanitarian concern
- Spirit of service
- Sense of duty
- Friendly relationship without discrimination

MODULE I : INTRODUCTION **8**

Origin-Fundamental Principles, Humanity, Impartiality, Neutrality, Independence, Voluntary service, Unity, Universality based activities like First Aid etc.

MODULE II : MOTTO **8**

Health-Protection of health and life , Service- Serving the sick and suffering, Friendship-Promoting it through program like Financial Literacy etc.

MODULE III :FEATURES OF YRC **8**

Organizing Committee-Structure-How to start a Unit- Core focus areas-Strategic Goals and Objectives through programs like Eye, Dental, General Health checkup etc.

MODULE IV :REGULAR ACTIVITIES **8**

Disaster Relief- Health and Medical Service-Training Courses-Human resource development through programs on the above areas

MODULE V :HUMANITARIAN PRINCIPLES **8**

Principle of Humanity-Principle of Distinction-Principle of Military Necessity-Principle of prevention of unnecessary suffering-Principle of Proportionality - programs on the above

Total Periods: 40

OUTCOMES: The students would have got their personality developed through

- Health awareness
- Civic responsibilities with humanitarian concern
- Spirit of service
- Sense of duty
- Friendly relationship without discrimination

References:

1. IRCS/YRC Handbook
2. https://www.indianredcross.org/youth/Guidelines-for-JYRC-LR.pdf

Unit -4 : NATIONAL *SPORTS ORGANISATION* (NSO)

L T P C
0 0 2 1

Objectives:

- To create awareness about basic fitness and mental strength
- To promote the development of physical fitness
- To develop the sporting activities of the youth
- To create the social responsibility and social interaction through participation

Module 1 - **8 hours**

Introduction of Physical Education - History - Origin - Physical Fitness Test - Major games Skills Test.

Module 2 - **8 hours**

Importance of Basic Physical Fitness - BMI Calculation - Identification of deformities - Nutrition & Diet for fitness - Major games practice.

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Module 3 - 8 hours

Health Education - Physical Fitness Activities (Speed - Strength - Endurance - Agility) minor games practice.

Module 4 - 8 hours

Major games introduction (Athletics - Badminton - Ball Badminton - Basketball - Chess - Cricket - Football - Kabaddi - Kho-Kho - Table Tennis - Volleyball) and tournament.

Module 5 - 8 hours

Major games skills training - Physical Fitness Activities (50mtr dash - 800mtr run - sit ups/pushups - shuttle run) Assessments.

Total - 40 hours

Outcomes:

- Get basic knowledge about physical and mental fitness and gain physical fitness and mental fitness
- NSO create-esteem and self confidence
- NSO provide opportunity get social interaction
- Development of character and personality through participation

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1918301 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

L	T	P	C
3	1	0	4

OBJECTIVES:

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

UNIT-I: PARTIAL DIFFERENTIAL EQUATIONS 9L+3T

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

UNIT-II: FOURIER SERIES 9L+3T

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

UNIT-III: APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9L+3T

Classification of PDE – Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction in infinite plates(excluding insulated edges).

UNIT-IV: FOURIER TRANSFORMS 9L+3T

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

UNIT-V: Z – TRANSFORMS AND DIFFERENCE EQUATIONS 9L+3T

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

TOTAL: 45L +15T PERIODS

OUTCOMES:

- Understand the fundamental concept of the concepts of Partial differential Equations.
- Understand the basic concepts of mathematical principles on Fourier & Z-transforms.
- Apply the concept of PDE and Solve Wave equation, and Heat flow equations.

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- Understand the concept Fourier series and apply the concept in solving PDE.
- Understand the fundamental concept of the concepts of Solution of difference equations

TEXT BOOKS:

1. Veerarajan. T., “Transforms and Partial Differential Equations”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., “Higher Engineering Mathematics”, 42nd Edition, Khanna Publishers, Delhi, 2012.
3. Narayanan.S., ManicavachagomPillay.T.K and Ramanaiah.G “Advanced Mathematics for Engineering Students” Vol. II & III, S. Viswanathan Publishers Pvt. Ltd.1998.

REFERENCE BOOKS:

1. Bali.N.P and Manish Goyal, “A Textbook of Engineering Mathematics”, 7th Edition, Laxmi Publications Pvt Ltd, 2007.
2. Ramana.B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, “Advanced Modern Engineering Mathematics”, 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig,“Advanced Engineering Mathematics”, 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, “Advanced Engineering Mathematics” Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. P.Sivaramakrishna Das, C.Vijayakumari, Transforms and Partial Differential Equations, Pearson India Education Services Pvt. Ltd, 2019.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO2	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO3	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO4	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO5	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-

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1906301 **ELECTRONIC DEVICES AND CIRCUITS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To learn the basic concept of circuit theorems and semiconductor diode.
- To acquaint the students with the theory, operation and characteristics of Bipolar Junction Transistors.
- To understand the basic concepts of Field effect Transistors.
- To analyse the characteristics of special semiconductor devices.
- To get familiar with Power control devices, LED, LCD and other Opto-electronic devices.

UNIT – I: CIRCUIT THEOREMS AND SEMICONDUCTOR DIODE 9

Ohm‘s Law – Kirchhoff‘s laws – Superposition theorem, Thevenin‘s theorem, Norton‘s theorem, Reciprocity theorem and Maximum power transfer theorem. PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes.

UNIT – II: BIPOLAR JUNCTION TRANSISTORS 9

NPN -PNP -Operations-Early effect-Current equations – Input and Output characteristics of CE, CB, CC - Hybrid -π model - h-parameter model, Ebers Moll Model- Gummel Poon-model, Multi Emitter Transistor.

UNIT – III: FIELD EFFECT TRANSISTORS 9

JFETs – Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance- JFET as a Voltage Variable Resister, MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET.

UNIT – IV: SPECIAL SEMICONDUCTOR DEVICES 9

Metal-Semiconductor Junction- MESFET, FINFET, PINFET, CNTFET, DUAL GATE MOSFET, Schottky barrier diode-Zener diode-Varactor diode –Tunnel diode- Gallium Arsenide device, LASER diode, LDR, Gunn diode**.**

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UNIT – V: POWER DEVICES AND DISPLAY DEVICES 9

UJT, SCR, Diac, Triac, Power BJT- Power MOSFET- DMOS-VMOS. LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD.

TOTAL PERIODS:45

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

- Develop the capacity to apply circuit theorems in real time.
- Understand the characteristics of PN junction diode.
- Explain the V-I characteristic of UJT and SCR.
- Describe the equivalence circuits of Bipolar Junction Transistors.
- Operate the basic electronic devices such as Field effect Transistors, Power control devices, LED, LCD and other Opto-electronic devices.

TEXT BOOKS:

1. Donald A Neaman, "Semiconductor Physics and Devices‖", Fourth Edition, Tata Mc GrawHill Inc. 2012.
2. Robert Boylestad and Louis Nashelsky, "Electron Devices and Circuit Theory", Pearson Prentice Hall, 10th edition, July 2008.

REFERENCE BOOKS:

1. Salivahanan. S, Suresh Kumar. N, Vallavaraj.A, "Electronic Devices and circuits‖", Third Edition, Tata McGraw- Hill, 2008.
2. R.S.Sedha," A Text Book of Applied Electronics", S.Chand Publications, 2006.
3. Yang, "Fundamentals of Semiconductor devices", McGraw Hill International Edition, 1978.
4. Floyd, "Electronic Devices", Ninth Edition, Pearson Education, 2012.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	-	-	-	-	-	-	-	-	2	3	-	-	-
2	3	3	2	-	-	-	-	-	-	-	-	2	2	-	-	-
3	3	3	-	-	-	-	-	-	-	-	-	2	2	-	-	-
4	3	3	2	-	-	-	-	-	-	-	-	2	3	-	-	-
5	3	2	3	-	-	-	-	-	-	-	-	2	2	-	-	-

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1906302 **ANALOG ELECTRONICS - I** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the methods of biasing transistors.
- To design and analyze single stage and multistage amplifier circuits.
- To understand the methods of biasing transistors.
- To analyze the frequency response of small signal amplifiers.
- To design and analyze the regulated DC power supplies.

UNIT - I: BIASING OF DISCRETE BJT, JFET AND MOSFET 9

BJT– Need for biasing - DC Load Line and Bias Point – DC analysis of Transistor circuits – Various biasing methods of BJT – Bias Circuit Design - Thermal stability - Stability factors - Bias compensation techniques using Diode, thermistor and sensistor – Biasing BJT Switching Circuits- JFET - DC Load Line and Bias Point - Various biasing methods of JFET - JFET Bias Circuit Design - MOSFET Biasing - Biasing FET Switching Circuits.

UNIT - II: BJT AMPLIFIERS 9

Small Signal Hybrid π equivalent circuit of BJT – Early effect - Analysis of CE, CC and CB amplifiers using Hybrid π equivalent circuits - AC Load Line Analysis- Darlington Amplifier - Bootstrap technique - Cascade, Cascode configurations - Differential amplifier, Basic BJT differential pair – Small signal analysis and CMRR.

UNIT - III: SINGLE STAGE FET, MOSFET AMPLIFIERS 9

Small Signal Hybrid π equivalent circuit of FET and MOSFET - Analysis of CS, CD and CG amplifiers using Hybrid π equivalent circuits - Basic FET differential pair- BiCMOS circuits.

UNIT - IV: FREQUENCY RESPONSE OF AMPLIFIERS 9

Amplifier frequency response – Frequency response of transistor amplifiers with circuit capacitors – BJT frequency response – short circuit current gain - cut off frequency – f_α, f_β and unity gain bandwidth – Miller effect - frequency response of FET - High frequency analysis of CE and MOSFET CS amplifier - Transistor Switching Times.

UNIT - V: POWER SUPPLIES AND ELECTRONIC DEVICE TESTING 9

Linear mode power supply - Rectifiers - Filters - Half-Wave Rectifier Power Supply - Full-Wave Rectifier Power Supply - Voltage regulators: Voltage regulation - Linear series, shunt and switching Voltage Regulators - Over voltage protection - BJT and MOSFET –

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Switched mode power supply (SMPS) - Power Supply Performance and Testing - Troubleshooting and Fault Analysis, Design of Regulated DC Power Supply.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Understand the working principles, characteristics and applications of BJT and FET.
- Determine the frequency response of BJT and FET amplifiers.
- Analyze the performance of small signal BJT and FET amplifiers - single stage and multi stage amplifiers.
- Design the Electronic amplifier circuits.
- Troubleshoot and perform fault analysis of power supplies.

TEXT BOOKS:

1. Donald. A. Neamen, "Electronic Circuits Analysis and Design", 3rd Edition, Mc Graw Hill Education (India) Private Ltd., 2010.
2. Robert L. Boylestad and Louis Nasheresky,"Electronic Devices and Circuit Theory", 11th Edition, Pearson Education, 2013.

REFERENCE BOOKS:

1. Millman J, Halkias.C.and Sathyabrada Jit, "Electronic Devices and Circuits", 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2015.
2. Salivahanan and N. Suresh Kumar, "Electronic Devices and Circuits", 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2017.
3. Floyd,"Electronic Devices", Ninth Edition, Pearson Education, 2012.
4. David A. Bell, "Electronic Devices & Circuits", 5th Edition, Oxford University Press, 2010.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	-	-	-	-	-	-	-	2	3	2	-	-
2	3	3	3	3	-	-	-	-	-	-	-	2	3	2	3	-
3	3	3	3	3	-	-	-	-	-	-	-	2	3	1	3	-
4	3	3	3	3	-	-	-	-	-	-	-	2	3	1	2	-
5	3	3	3	3	-	-	-	-	-	-	-	2	3	1	2	-

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1906001 **SIGNALS AND SYSTEMS** **L T P C**

3 0 0 3

OBJECTIVES:

The students should be made:

- To understand the basic properties of signal & systems.
- To explore the methods of characterization of LTI systems in time domain.
- To analyze continuous time signals and system in the Fourier and Laplace domain.
- To examine the discrete time signals and system in the Fourier and Z transform domain.
- To correlate the signals and systems in real time applications.

UNIT – I: CLASSIFICATION OF SIGNALS AND SYSTEMS 9

Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids -Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT – II: ANALYSIS OF CONTINUOUS TIME SIGNALS 9

Fourier series for periodic signals - Fourier Transform – Inverse Fourier Transform - properties- Laplace Transforms – Inverse Laplace Transform - and properties.

UNIT – III: LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS 9

Impulse response - convolution integrals- Differential Equation- Fourier and Laplace transforms in Analysis of CT systems - Systems connected in series / parallel.

UNIT – IV: ANALYSIS OF DISCRETE TIME SIGNALS 9

Baseband signal Sampling – Fourier Transform of discrete time signals (DTFT) - Inverse DTFT- Properties of DTFT - Z Transform Inverse Z Transform - & Properties.

UNIT – V: LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9

Impulse response – Convolution sum - Difference equations- - Discrete Fourier Transform and Z Transform Analysis of Recursive & Non-Recursive systems-DT systems connected in series and parallel.

TOTAL PERIODS: 45

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OUTCOMES:

On completion of this course, the student should be able to

- Discriminate the nature of the given system as linear/causal/stable.
- Determine the frequency components present in a deterministic signal.
- Characterize the LTI systems in the time domain and frequency domain.
- Compute the output of an LTI system in the time and frequency domains.
- Realize the signals and systems in the real time applications.

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2015.
2. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.

REFERENCE BOOKS:

1. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson, 2007.
2. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.
3. Simon Haykin, Barry Van Veen, “Signals and Systems”, John Wiley & Sons, Inc, 2005.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	1	1	-	-	-	-	-	-	-	1	2	2	-	-
2	3	2	1	1	-	-	-	-	-	-	-	1	2	2	-	-
3	3	2	1	1	-	-	-	-	-	-	-	1	2	2	-	-
4	3	2	1	3	-	-	-	-	-	-	-	1	2	2	-	-
5	3	2	1	3	-	-	-	-	-	-	-	3	2	2	-	-

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1906303	DIGITAL ELECTRONICS	L T P C
		3 0 0 3

OBJECTIVES:

The student should be able

- To understand the Digital fundamentals, Boolean algebra and its applications in digital systems.
- To familiarize with the design of various combinational digital circuits using logic gates.
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits.
- To improve the design skill in reconfigurable and memory device.
- To introduce the Hardware description Language for design combinational and sequential circuits.

UNIT – I: DIGITAL FUNDAMENTALS 9

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT – II: COMBINATIONAL CIRCUIT DESIGN 9

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT – III: SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT – IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

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UNIT – V: MEMORY DEVICES AND INTRODUCTION TO HDL PROGRAMMING 9

Basic memory structure- ROM-PROM-EPROM-EEPROM-EAPROM, RAM – Static and Dynamic RAM- Programmable Logic Devices-Programmable Logic Array (PLA) – Programmable Array Logic (PAL). Introduction to HDL: Behavioral – data flow, and algorithmic and structural description, lexical elements, data objects types, attributes, operators for Verilog HDL. Examples for Combinational and Sequential circuits.

TOTAL PERIODS:45

OUTCOMES:

After studying this course, the student should be able to,

- Understand the fundamentals of Number systems and their conversions.
- Apply the logical knowledge in the design of combinational circuits.
- Analyze the concepts of sequential circuits and able to design sequential circuits in terms of state machines.
- Implement combinational and sequential circuits using Hardware Description Language.
- Design the programmable hardware.

TEXT BOOKS:

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.
2. Samir Palnitkar – “Verilog HDL A guide to Digital design and Synthesis”, 2nd Edition, Prentice Hall, 2003.

REFERENCE BOOKS:

1. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
2. Anil K.Maini “Digital Electronics”, Wiley, 2014.
3. S.Salivahanan and S.Arivazhagan “Digital Electronics”, First Edition, Vikas Publishing House pvt. Ltd., 2012.
4. A.Anand Kumar “Fundamentals of Digital Circuits”, 4th Edition, PHI Learning Private Limited, 2016.
5. Nazeih M.Botros “HDL programming VHDL and Verilog”, Dreamtech Press, Reprint Edition 2009.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-
2	3	3	1	2	-	-	-	-	-	-	-	-	2	-	-	-
3	3	3	1	2	-	-	-	-	-	-	-	-	2	1	-	-
4	3	2	3	2	3	2	-	-	-	-	-	1	3	1	2	-
5	3	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-

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1905009 CONTROL SYSTEMS ENGINEERING

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To introduce the components and their representation of control systems.
- To learn various methods for analyzing the time response analysis of the systems.
- To learn various methods for analyzing the frequency response analysis and compensator design of the system.
- To learn various methods for analyzing the stability of the systems.
- To learn the various approach for the state variable analysis.

UNIT-I: SYSTEMS COMPONENTS AND THEIR REPRESENTATION 9

Control System : Terminology and Basic Structure-Open loop and Closed Loop Systems- Feed forward and Feedback control theory- Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems- Synchros -Multivariable control system.

UNIT-II: TIME REPONSE ANALYSIS 9

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD,PI,PID control systems.

UNIT-III: FREQUENCY RESPONSE AND SYSTEM ANALYSIS 9

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system - Bode Plot - Polar Plot - Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag - lead compensation

UNIT-IV: CONCEPTS OF STABILITY ANALYSIS 9

Concept of stability-Bounded - Input Bounded- Output stability-Routh stability criterion-Relative stability - Root locus concept-Guidelines for sketching root locus - Nyquist stability criterion.

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UNIT-V: CONTROL SYSTEM ANALYSIS USING STATE VARIABLE METHODS 9

State variable representation-Conversion of state variable models to transfer functions-Conversion of transfer functions to state variable models - Solution of state equations-Concepts of Controllability and Observability-Stability of linear systems- Equivalence between transfer function and state variable representations-State variable analysis of digital control system-Digital control design using state feedback.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Identify the various control system components and their representations.
- Analyze the various time domain parameters.
- Analysis the various frequency response plots and its system.
- Apply the concepts of various system stability criterions.
- Design various transfer functions of digital control system using state variable models.

TEXTBOOKS:

1. M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.
2. Benjamin C. Kuo, "Automatic Control Systems", Wiley, 2014.

REFERENCE BOOKS:

1. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
2. Richard C.Dorf and Bishop, R.H., "Modern Control Systems", Pearson Education,Twelth Edition,2011.
3. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", New Age International Publishers, 2017.
4. Rames C.Panda and T. Thyagarajan, "An Introduction to Process Modelling Identification and Control of Engineers", Narosa Publishing House, 2017.
5. S.K.Bhattacharya, Control System Engineering, 3rd Edition, Pearson, 2013.

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2	1	-	-	-	2	1	-	-	1	-	-
2	1	1	1	1	1	-	-	-	-	-	-	2
3	-	2	2	-	-	-	-	-	-	1	-	-
4	1	-	1	2	1	-	1	-	-	-	1	-
5	-	1	-	1	2	-	-	2	1	-	-	2

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1906304 ELECTRONIC DEVICES AND CIRCUITS LABORATORY **L T P C 0 0 4 2**

OBJECTIVES:

The student should be made to:

- To gain hands on experience in basic circuit theorems.
- To learn the characteristics of basic electronic devices such as Diode, BJT, FET, SCR.
- To understand the operation of clipper and clamper & rectifier.
- To analyze the characteristics of an amplifiers.
- Simulate diode characteristics and rectifiers.

LIST OF EXPERIMENTS:

1. Verifications of Thevenin's & Norton's theorem.
2. Verifications of KVL & KCL.
3. Verifications of Super Position Theorem.
4. Verifications of maximum power transfer & reciprocity theorem.
5. Analyse the Characteristics and application of PN Junction Diode.
6. Analyse the Characteristics of Zener diode & design a Regulator using Zener diode.
7. Common Emitter input-output Characteristics.
8. Common Base input-output Characteristics.
9. Analysis of FET Characteristics.
10. Analysis of SCR Characteristics.
11. Design and test Clipper and Clamper & FWR.
12. Simulation of diode characteristics and Rectifiers using PSPICE.

TOTAL PERIODS:60

OUTCOMES:

On completion of this lab course, the student would be able to,

- Develop the capacity to apply circuit theorems in real time.
- Analyse the characteristics of basic electronic devices such as Diode, BJT, FET and SCR.
- Perform experiment to analyse input-output characteristics of CE and CB amplifiers.
- Test the performance of clipper and clamper & FWR.
- Simulate and analyse diode characteristics and rectifiers using SPICE.

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LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

S.NO	NAME OF THE EQUIPMENT	REQUIRED
1.	BC 107, BC 148, 2N2646, BFW10	10 each
2.	1N4007, Zener diodes - 25 each	10 each
3.	Resistors, Capacitors, Inductors	sufficient quantities
4.	Bread Boards	10 Nos
5.	CRO (30MHz)	10 Nos.
6.	Function Generators (3MHz)	10 Nos.
7.	Dual Regulated Power Supplies (0 – 30V)	10 Nos.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	1	-	-	-	-	1	2	-	2	2	3	-	-	2
2	3	3	2	2	-	-	-	1	2	-	2	2	2	2	-	2
3	3	3	2	2	-	-	-	1	2	-	2	2	2	2	-	2
4	3	3	3	1	-	-	-	1	2	-	2	2	3	-	-	2
5	3	3	1	2	3	-	-	1	2	-	2	2	2	2	3	2

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1906305 ANALOG AND DIGITAL ELCTRONICS LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

The student should be made to:

- Determine the Frequency response of CE, CB and CC Amplifier.
- Learn the frequency response of CS Amplifiers.
- Study the Transfer characteristics of differential amplifier.
- Perform experiment to obtain the bandwidth of single stage and multistage. Amplifiers.
- Do SPICE simulation of Electronic Circuits.

LIST OF ANALOG EXPERIMENTS:

1. Design of Regulated Power supplies.
2. Frequency Response of CE, CB, CC and CS amplifiers.
3. Darlington Amplifier.
4. Differential Amplifiers - Transfer characteristics, CMRR Measurement.
5. Cascode and Cascade amplifiers.
6. Determination of bandwidth of single stage and multistage amplifiers.
7. Analysis of BJT with Fixed bias and Voltage divider bias using Spice
8. Analysis of FET, MOSFET with fixed bias, self-bias and voltage divider bias using simulation software like Spice.
9. Analysis of Cascode and Cascade amplifiers using Spice.
10. Analysis of Frequency Response of BJT and FET using Spice.

LIST OF DIGITAL EXPERIMENTS:

1. Design and implementation of code converters using logic gates (i) BCD to excess-3 code and vice versa (ii) Binary to gray and vice-versa.
2. Design and implementation of 4 bit binary Adder/ Subtractor and BCD adder using IC 7483.
3. Design and implementation of Multiplexer and De-multiplexer using logic gates.
4. Design and implementation of encoder and decoder using logic gates.
5. Construction and verification of 4 bit ripple counter and Mod-10 / Mod-12 Ripple counters.
6. Design and implementation of 3-bit synchronous up/down counter.

TOTAL PERIODS: 60

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OUTCOMES:

On completion of this lab course, the student would be able to,

- Test rectifiers, filters and regulated power supplies.
- Understand BJT/JFET amplifiers.
- Design Cascode and cascade amplifiers.
- Analyze the limitation in bandwidth of single stage and multi stage amplifier.
- Simulate and analyze amplifier circuits using PSpice.

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS, 2 STUDENTS / EXPERIMENT:

S.NO	EQUIPMENTS FOR ANALOG LAB	REQUIRED
1.	CRO/DSO (30MHz)	15 Nos
2.	Signal Generator /Function Generators (3 MHz)	15 Nos
3.	Dual Regulated Power Supplies (0 – 30V)	15 Nos.
4.	Standalone desktop PCs with SPICE software	15 Nos
5.	Transistor/FET (BJT-NPN-PNP and NMOS/PMOS)	50 Nos
6.	Components and Accessories: Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers.	-
7.	SPICE Circuit Simulation Software: (any public domain or commercial software)	-

S.NO	EQUIPMENTS FOR DIGITAL LAB	REQUIRED
1.	Dual power supply/ single mode power supply.	15 Nos
2.	IC Trainer Kit.	15 Nos
3.	Bread Boards	15 Nos
4.	Seven segment display	15 Nos
5.	Multimeter	15 Nos
6.	ICs each 50 Nos. 7400/ 7402 / 7404 / 7486 / 7408 / 7432 / 7483 / 74150 / 74151 / 74147 / 7445 / 7476/7491/ 555 / 7494 / 7447 / 74180 /7485 / 7473 / 74138 / 7411 / 7474	–

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	2	3	2	-	-	3	3	-	1	3	3	3	1
2	3	2	2	2	3	2	-	-	3	2	-	2	3	3	3	1
3	3	2	2	2	3	2	-	-	2	3	-	2	3	3	3	1
4	3	2	2	3	3	2	-	-	3	3	-	3	3	3	3	1
5	3	2	3	3	3	2	-	-	3	2	-	2	3	3	3	1

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1919001 COMMUNICATION SKILLS LABORATORY – PROJECT BASED L T P C
0 0 2 0

OBJECTIVES:

The Course will enable learners to:

- Equip students with the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
- Provide guidance and practice in basic general and classroom conversation and to engage in specific academic speaking activities and make effective presentations.
- Improve general and academic listening skills and technical writing skills.
- Strengthen the reading skills of students of engineering.
- Provide more opportunities to develop their project and proposal writing skills.

UNIT- I: Informal Communication – An Introduction 6

Listening - Listening as a key skill- its importance- **Speaking -** give personal information - ask for personal information - express ability - enquire about ability – rephrase for clarification or emphasis - Improving pronunciation – Articulation of speaking –vowel sounds. **Reading** – Strategies for effective reading- Read and recognize different text types in a newspaper - **Writing**-Plan before writing- Develop a paragraph: topic sentence, supporting sentences, concluding sentence.

UNIT- II: Mechanics of Basic Communication 6

Listening - Listen to a process information- **Speaking** - asking for details formal/informal – give views, opinions and justification of a news- consonant sounds –diphthongs -.**Reading**- Read for vocabulary through scientific invention summarise the same into a paragraph- . **Writing**- compare and contrast ideas using adjectives from multiple sources stating reasons and examples to support ideas. Write a paragraph with reasons and examples- Write a Rejoint to a newspaper expressing opinions on particular news.

UNIT- III: Nuances of LSRW 6

Listening - Lexical chunking for accuracy and fluency- factors that influence fluency- listen for and follow the gist- listen for detail **Speaking** - deliver a five-minute informal talk - invite and offer - accept - decline - take leave - word stress – stress rules-ability to recognize RP sound- . **Reading**– Skimming / Scanning a text to apply both the concepts – to search – to analyze.**Writing**–Use of dictionary and usage of synonyms- editing and proof reading.

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UNIT- IV: Technical Communication – Basic presentation Skills 6

Listening - Being an active listener: giving verbal and non-verbal feedback- listening to a podcast of a native speaker and reciprocating **Speaking** - participating in a group discussion - conversational speech listening to and participating in conversations - persuade.– Sentence stress – intonations types-features of connected speech **Reading**– Genre and Organization of Ideas- note taking and summarizing **Writing–**Email writing- Job application- Blog writing.

UNIT-V: Communication Skills for Formal Occasion 6

Listening- Listening to documentaries and make notes (TED talks) **Speaking** -Power point presentation - strategies for presentations and interactive communication - group/pair presentations –use stress and intonation to convey meaning and nuances of meaning clearly- **Reading**– Technical passages for comprehension- understanding how the text positions the reader- **Writing**– Statement of Purpose - analyse the situation in a picture / photo and write a suitable description with a proper title.

TOTAL PERIODS: 30

The lab course is offered as an **Employability Enhancement Course**

The Course will have an Internal End semester exam includes a **project work**. The Students need to have **75% attendance** for the completion of the course.

OUTCOMES:

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

- Read and evaluate texts critically
- Make effective presentations
- Participate confidently and appropriately in conversations both formal and informal
- Write winning job applications.
- Display critical thinking in various professional contexts.

REFERENCE BOOKS:

1. Gramer F.Margot and Colin S.Ward ‘Reading and Writing’ (Level 3) Oxford University Press: Oxford, 2011.
2. Debra Daise, CharlNorloff, and Paul ‘Reading and Writing’ (Level 4) Oxford University Press: Oxford, 2011
3. Brooks, Margret. ‘Skills for Success. Listening and Speaking.’ (Level 4)Oxford University Press, Oxford: 2011.

4. Richards,C. Jack. & David Bholke. 'Speak Now'(Level 3.) Oxford University Press, Oxford: 2010
5. Davis,Jason and Rhonda LIss. 'Effective Academic Writing' (Level 3) Oxford University Press: Oxford, 2006
6. E.Suresh Kumar. 'Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
7. Petelin, Roslyn and Marsh Durham. 'The Professional Writing Guide: Knowing Well and Knowing Why'. Business & Professional Publishing: Australia, 2004.
8. Bhatnagar, Nitin and Mamta Bhatnagar. 'Communicative English for Engineers and Professionals'. Pearson: New Delhi, 2010.
9. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
10. Vargo, Mari. Speak Now (Level 4). Oxford University Press: Oxford, 2013.
11. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
12. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014
13. IELTS, TOFEL testing series
14. Jack c. Richards. Tactics for Listening: Developing. Oxford University Press: Oxford,.2004
15. New Oxford Dictionary for writers and editors: The essential A-Z Guide to the Written Word 2005.

CO - PO and CO - PSO MAPPING:

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	3	3	-	-	-	-	3	-	1	2	2	1	2
CO2	3	2	3	2	2	-	2	-	-	3	-	1	2	1	1	2
CO3	3	3	-	2	-	-	-	-	-	3	-	1	1	1	1	1
CO4	3	3	-	-	-	-	3	-	-	2	-	1	1	1	1	1
CO5	3	2	2	-	-	-	-	-	-	3	-	1	2	1	1	2

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1918403 **PROBABILITY AND RANDOM PROCESSES**

L T P C
3 1 0 4

OBJECTIVES:

- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in IT fields.
- To understand the concept of correlation and spectral densities.
- To understand the significance of linear systems with random inputs.

UNIT-I: RANDOM VARIABLES 9L+3T

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT-II: TWO - DIMENSIONAL RANDOM VARIABLES 9L+3T

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables, Central limit Theorem.

UNIT-III: RANDOM PROCESSES 9L+3T

Classification – Stationary process – Markov process - Markov chain – Chapman Kolmogorov equations – Limiting distributions - Poisson process – Gaussian process.

UNIT-IV: CORRELATION AND SPECTRAL DENSITIES 9L+3T

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

UNIT-V: LINEAR SYSTEM WITH RANDOM INPUTS 9L+3T

Linear time invariant system-System transfer function-Auto correlation and cross correlation functions of input and output.

TOTAL: 45L+15T PERIODS

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OUTCOMES:

- Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept random processes in engineering disciplines
- Understand and apply the concept of correlation and spectral densities
- The students will have an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable. Able to analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS:

1. T.Veerarajan, Probability, Statistics and Random processes, Tata McGraw-Hill, 5th Edition,2008
2. Peebles Jr. P.Z.,Probability Random Variables and Random Signal Principles, Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2002.

REFERENCE BOOKS:

1. Robertazzi, "Computer Networks and Systems: Queueing Theory and performance evaluation", Springer, 3rd Edition, 2006.
2. KishorS.Trivedi, “Probability and Statistics with Reliability, Queueing and Computer Science Applications, John Wiley & Sons Inc. Second Edition, 2002
3. J.Medhi, Stochastic Processes, New Age International (P) Ltd., Second Edition, 1994.
4. Yates. R.D.&Goodman.D. J."Probability and Stochastic Processes", Wiley India Pvt. Ltd., 2006
5. P. Sivaramakrishna Das, C. Vijayakumari, “ Probability and Random Processes”,Pearson Publications,2nd Edition 2016.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	2	1	-	-	-	-	-	1	1	1	-	-	-
CO2	3	3	3	2	1	-	-	-	-	-	1	1	1	-	-	-
CO3	3	3	3	2	1	-	-	-	-	-	1	1	1	-	-	-
CO4	3	3	3	2	1	-	-	-	-	-	1	1	1	-	-	-
CO5	3	3	3	2	1	-	-	-	-	-	1	1	1	-	-	-

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1906401 **LINEAR INTEGRATED CIRCUITS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be able:

- To understand the basic building blocks of linear integrated circuits.
- To familiarize the applications of analog integrated circuits.
- To explore the theory and applications of analog multipliers and PLL.
- To acquire knowledge on the functioning of ADC and DAC.
- To explain the concepts of waveform generation and introduce some special function ICs.

UNIT – I: BASICS OF OPERATIONAL AMPLIFIERS 9

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages and internal circuit diagrams of IC 741, DC and AC performance characteristics, Op-Amp parameters & Measurement, Input & Out put Off set voltages & currents, Slew rate, Open and closed loop configurations, JFET Operational Amplifiers – LF155 and TL082.

UNIT – II: APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, AC amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

UNIT – III: ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronisation.

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UNIT – IV: ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.

UNIT – V: WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS 9

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, , Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

TOTAL PERIODS: 45

OUTCOMES:

On completion of the course, the student should be able to,

- Design linear and nonlinear applications of opamp
- Construct the real time applications using analog multiplier and PLL.
- Design ADC and DAC using opamp..
- Apply the concept of waveforms generation using opamp.
- Analyze special function ICs and its usage.

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2018, Fifth Edition.

2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 4th Edition, Tata Mc Graw-Hill, 2016.

REFERENCES BOOKS:

1. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2015.

2. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001.

3. B.S.Sonde, “System design using Integrated Circuits” , 2nd Edition, New Age Pub, 2001.

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4. Gray and Meyer, “Analysis and Design of Analog Integrated Circuits”, Wiley International, 5th Edition, 2009.

5. William D.Stanley, “Operational Amplifiers with Linear Integrated Circuits”, Pearson Education, 4th Edition,2001.

6. S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH, 2nd Edition, 4th Reprint, 2016.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	2	-	-	-	-	-	-	-	2	2	2	-	-
2	3	3	3	2	-	-	-	-	-	-	-	2	2	2	-	-
3	3	3	3	2	-	-	-	-	-	-	-	2	2	2	-	-
4	3	2	2	2	-	-	-	-	-	-	-	2	3	3	-	-
5	3	2	2	3	-	-	-	-	-	-	-	2	2	2	-	-

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1906402 **ANALOG ELECTRONICS - II** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To give a comprehensive exposure to all types of amplifiers and oscillators constructed with discrete components. This helps to develop a strong basis for building linear and digital integrated circuits.
- To study about feedback amplifiers and oscillators principles.
- To design oscillators.
- To study about tuned amplifier.
- To understand the analysis and design of LC and RC oscillators, Multivibrators, power amplifiers and DC convertors.

UNIT - I: FEEDBACK AMPLIFIERS AND STABILITY 9

Feedback Concepts – gain with feedback – effect of feedback on gain stability, distortion, bandwidth, input and output impedances; topologies of feedback amplifiers – analysis of series-series, shunt-shunt and shunt-series feedback amplifiers-stability problem-Gain and Phase-margins-Frequency compensation.

UNIT - II: OSCILLATORS 9

Barkhausen criterion for oscillation – phase shift, Wien bridge - Hartley & Colpitt's oscillators – Clapp oscillator-Ring oscillators and crystal oscillators – oscillator amplitude stabilization.

UNIT - III: TUNED AMPLIFIERS 9

Coil losses, unloaded and loaded Q of tank circuits, small signal tuned amplifiers – Analysis of capacitor coupled single tuned amplifier – double tuned amplifier - effect of cascading single tuned and double tuned amplifiers on bandwidth – Stagger tuned amplifiers - Stability of tuned amplifiers – Neutralization - Hazeltine neutralization method.

UNIT - IV: WAVE SHAPING AND MULTIVIBRATOR CIRCUITS 9

Pulse circuits – attenuators – RC integrator and differentiator circuits – diode clampers and clippers –Multivibrators - Schmitt Trigger- UJT Oscillator.

UNIT - V: POWER AMPLIFIERS AND DC CONVERTERS 9

Power amplifiers- class A-Class B-Class AB-Class C-Power MOSFET-Temperature Effect-Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

TOTAL PERIODS: 45

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OUTCOMES:

The student should be able to:

- Analyze different types of amplifier, oscillator and multivibrator circuits.
- Evaluate BJT amplifier and oscillator circuits.
- Examine transistorized amplifier and oscillator circuits.
- Design and analyze feedback amplifiers.
- Understand LC and RC oscillators, tuned amplifiers, wave shaping circuits, Multivibrators, power amplifier and DC convertors.

TEXT BOOKS:

1. Sedra and Smith, “Micro Electronic Circuits” Seventh Edition, Oxford University Press, 2015.
2. Jacob Millman, “Microelectronics”, McGraw Hill, 2nd Edition, Reprinted, 2017.

REFERENCE BOOKS:

1. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008
2. David A. Bell, “Electronic Devices and Circuits”, Fifth Edition, Oxford University Press, 2008.
3. Millman J. and Taub H., “Pulse Digital and Switching Waveforms”, TMH, 2000.
4. Millman and Halkias. C., “Integrated Electronics”, TMH, 2007.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	3	3	3	-	-	-	-	-	-	-	2	3	2	-	-
2	3	3	3	3	-	-	-	-	-	-	-	2	3	2	3	-
3	3	3	3	3	-	-	-	-	-	-	-	2	3	1	3	-
4	3	3	3	3	-	-	-	-	-	-	-	2	3	1	2	-
5	3	3	3	3	-	-	-	-	-	-	-	2	3	1	2	-

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1906403 **COMMUNICATION THEORY** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To introduce the concepts of amplitude modulations and their spectral characteristics.
- To discuss various angle modulations and their spectral characteristics.
- To understand the properties of random process.
- To know the effect of noise on communication systems.
- To study the process of sampling & quantization.

UNIT - I: AMPLITUDE MODULATION 9

Amplitude Modulation- DSBSC, DSBFC, SSB, VSB - Modulation index, Spectra, Power relations and Bandwidth – AM Generation – Square law and Switching modulator, DSBSC Generation – Balanced and Ring Modulator, SSB Generation – Filter, Phase Shift and Third Methods, VSB Generation – Filter Method, Hilbert Transform, Pre-envelope & Complex envelope –Comparison of different AM techniques, Super heterodyne Receiver.

UNIT - II: ANGLE MODULATION 9

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth - FM modulation –Direct and Indirect methods, FM Demodulation – FM to AM conversion, FM Discriminator - PLL as FM Demodulator.

UNIT - III: RANDOM PROCESS 9

Random variables, Random Process, Stationary Processes, Mean, Correlation & Covariance functions, Power Spectral Density, Ergodic Processes, Gaussian Process, Transmission of a Random Process Through a LTI filter.

UNIT - IV: NOISE CHARACTERIZATION 9

Noise sources – Noise figure, Noise temperature and Noise bandwidth – Noise in cascaded systems. Representation of Narrow band noise –In-phase and quadrature, Envelope and Phase – Noise performance analysis in AM & FM systems – Threshold effect, Capture effect, Pre-emphasis and de-emphasis for FM.

UNIT - V: SAMPLING & QUANTIZATION **9**

Low pass sampling – Aliasing- Signal Reconstruction-Quantization - Uniform & non-uniform quantization - Quantization noise - Logarithmic Companding –PAM, PPM, PWM, PCM – TDM, FDM.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Design AM communication systems.
- Design Angle modulated communication systems.
- Apply the concepts of Random Process to the design of Communication systems.
- Analyse the noise performance of AM and FM systems.
- Gain knowledge in sampling and quantization.

TEXT BOOKS:

1. J.G.Proakis, M.Salehi, “Fundamentals of Communication Systems”, Pearson Education 2014.
2. Simon Haykin, “Communication Systems”, 4th Edition, Wiley, 2014.

REFERENCE BOOKS:

1. B.P.Lathi, ”Modern Digital and Analog Communication Systems”, 3rd Edition, Oxford University Press, 2007.
2. D.Roody, J.Coolen, ”Electronic Communications”, 4th edition PHI 2006.
3. A.Papoulis, ”Probability, Random variables and Stochastic Processes”, McGraw Hill, 3rd edition, 1991.
4. B.Sklar, ”Digital Communications Fundamentals and Applications”, 2nd Edition Pearson Education 2007.
5. H P Hsu, Schaum Outline Series “Analog and Digital Communications” TMH 2006.

OURSE OUTCOMS - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	1	1	-	2	-	-	-	1	-	1	3	-	-	-
2	3	2	3	2	-	3	3	3	-	-	-	1	3	-	-	-
3	3	2	1	2	-	2	-	2	-	1	-	-	3	2	-	-
4	3	3	3	3	-	3	3	3	-	2	-	-	3	-	-	-
5	3	-	2	2	-	3	3	2	-	2	-	2	2	2	-	-

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1906404 **ELECTROMAGNETIC FIELDS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To gain conceptual and basic mathematical understanding of electric and magnetic fields in free space and in materials.
- To solve problems based on the Electric field concepts and laws.
- To be able to solve problems based on the Magnetic field concepts and laws.
- To understand the coupling between electric and magnetic fields through Faraday's law, displacement current and Maxwell's equations.
- To know about the wave propagation in lossless and in lossy media.

UNIT – I: INTRODUCTION **9**

Electromagnetic model, Units and constants, Review of vector algebra, Rectangular, Cylindrical and Spherical coordinate systems, Line, Surface and Volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem.

UNIT – II: ELECTROSTATICS **9**

Electric field, Coulomb's law, Gauss's law and applications, Electric potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density and dielectric constant, Boundary conditions, Capacitance, Parallel, Cylindrical and spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Point form of Ohm's law, Electromotive force and Kirchhoff's voltage law, Equation of continuity and Kirchhoff's current law.

UNIT – III: MAGNETOSTATICS **9**

Lorentz force equation, Law of no magnetic monopoles, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity and idea of relative permeability, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance, self-inductance and mutual inductance and Inductance of a solenoid and toroid, Magnetic energy, Magnetic forces and torques.

UNIT – IV: TIME-VARYING FIELDS AND MAXWELL's EQUATIONS **9**

Faraday's law, Displacement current , Gauss's law for magnetic field, Maxwell's four equations in integral and differential form, Potential functions, Electromagnetic boundary

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conditions, Wave equations and solutions, Time-harmonic fields, Electromagnetic power flow and Poynting vector.

UNIT – V: PLANE ELECTROMAGNETIC WAVES 9

Uniform Plane waves in lossless media, Plane waves in lossy media (low-loss dielectrics and good conductors), Group velocity, Normal incidence at a plane conducting boundary, Normal incidence at a plane dielectric boundary.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Apply vector calculus to understand the behavior of static electric and magnetic fields in standard configurations.
- Evaluate the capacitance and inductance of simple practical systems of conductors.
- Solve simple electrostatic and magneto static boundary problems.
- Analyze the relation between fields under time varying situations.
- Asses Maxwell‘s equations for electromagnetic wave propagation.

TEXT BOOKS:

1. D.K. Cheng, “Field and wave electromagnetics”, 2nd ed., Pearson (India), 1989.
2. W.H. Hayt and J.A. Buck, “Engineering electromagnetics”, 7th ed., McGraw-Hill (India), 2006.

REFERENCE BOOKS:

1. D.J. Griffiths, “Introduction to electrodynamics”, 4th ed., Pearson (India), 2013. M.N.O. Sadiku and S.V. Kulkarni, “Principles of electromagnetics”, 6th ed., Oxford (Asian Edition), 2015.
2. John D Kraus and Daniel A Fleisch, “Electromagnetics with Applications”, Mc Graw Hill Book Co, 2005.
3. G.S.N. Raju, “Electromagnetic Field Theory & Transmission Lines”, Pearson Education, 2006.
4. E.C. Jordan & K.G. Balmain “Electromagnetic Waves and Radiating Systems”, Pearson Education/PHI 4nd edition 2006.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	2	-	3	-	2	1	2	-	-	-	2	2	1	2	-
2	3	2	3	-	-	2	1	2	-	-	-	2	2	1	-	-
3	3	3	-	-	-	2	-	2	-	-	-	2	2	1	-	-
4	3	2	2	3	-	2	1	2	-	-	-	2	2	1	-	-
5	2	1	-	3	-	2	2	-	-	-	-	2	2	1	-	-

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1915001 **PROFESSIONAL ETHICS** **L T P C**

3 0 0 3

OBJECTIVES:

- To introduce and educate the students on the concept of Human Values.
- To enable the students to have awareness on Engineering Ethics theories and models.
- To make students understand the code of ethics and fundamental principles in social experiments in engineering.
- To educate on safety and risk aspects in engineering and to appreciate the rights of others.
- To create awareness about international issues related to ethics.

UNIT – I: HUMAN VALUES 9

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

UNIT – II: ENGINEERING ETHICS 9

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

UNIT – III: ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters - Engineer's Responsibilities to Economically Deprived People and Environment, Corruption – Codes of Ethics- Fundamental Principles – A Balanced Outlook on Law – Challenger Case Study

UNIT – IV: SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk –Government Regulator's approach to risks - The Three Mile Island, Chernobyl & Bhopal Case Studies, Greenery Effects - Collegiality and Loyalty - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Unethical Behaviour at Work Place – Reporting Unethical Behaviour- Professional Rights – Employee Rights – Intellectual Property Rights (IPR).

UNIT – V: INTERNATIONAL ISSUES 9

Multinational corporations - Business ethics - Environmental ethics - Internet ethics - Role in Technological Development - Weapons development-engineers as managers - Consulting Engineers - Engineers as expert witnesses and advisors - Honesty -

leadership - Sample code of conduct ethics - ASME, ASCE, IEEE, Institution of Engineers (India),Indian Institute of Materials Management Institution of electronics and telecommunication engineers (IETE), India – Corporate Social Responsibility, Indian and Western Culture – Cyber Crime.

TOTAL: 45 PERIODS

OUTCOMES:

- Students should be able to understand human values and apply ethics in societal issues.
- Students will be able to get understanding on nuances of engineering ethics.
- Student will have an understanding of engineer's responsibility to society and code of ethics
- Students will understand risk and safety issues related to engineering.
- Students will be able to advocate on applying ethical principles in international context.

TEXT BOOKS:

1. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011.
2. R. Subramanian, 'Professional Ethics' Oxford University Press, 2nd Edition 2017
3. R. S. Nagarazan, 'A Textbook on Professional Ethics and Human Values' New Age International Publishers, 2015
4. Sekhar, R.C., Ethical Choices in Business Response Books, New Delhi, Sage Publications,1997.

REFERENCE BOOKS:

1. Langford, Duncan (EDT): Internet Ethics, London, Macmillan Press Ltd., 2000.
2. Erwann, M. David, Michele S. Shauf, Computers, Ethics and Society, Oxford University Press,2003
3. Alan Kitson and Robert Campbell:" The Ethical Organisation", Red Globe Press, 2008.
4. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Professional Ethics and Human Values", Prentice Hall of India, New Delhi, 2013.
5. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 3rd edition (2017).

PO - CO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-	-	3	3	2	-	-	-	-	-	-	-	1
CO2	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	3	3	2	-	-	-	-	-	-	-	1
CO4	-	-	-	-	-	2	3	-	-	-	-	-	-	1	-	-
CO5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-

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1906405 LINEAR INTEGRATED CIRCUITS LABORATORY L T P C

0 0 4 2

OBJECTIVES:

The student should be made:

- To understand the basics of linear integrated circuits and available ICs.
- To observe the characteristics of the operational amplifier.
- To apply operational amplifiers in linear and nonlinear applications.
- To acquire the basic knowledge of special function IC.
- To use SPICE software for circuit design.

LIST OF HARDWARE EXPERIMENTS:

1. Design of Inverting, Non inverting and differential amplifiers.
2. Testing of Integrator and Differentiator.
3. Construction of Instrumentation amplifier.
4. Implementation of Active low-pass, High-pass and band-pass filters.
5. Astable & Monostable multivibrators using Op-amp.
6. Design of Schmitt Trigger using op-amp.
7. Testing of Phase shift and Wien bridge oscillators using Op-amp.
8. Implementation of Astable and Monostable multivibrators using NE555 Timer.
9. PLL characteristics and its use as Frequency Multiplier, Clock synchronization.
10. R-2R Ladder Type D to A Converter using Op-amp.
11. DC power supply design using LM317 and LM723.
12. Implementation of combinational logic circuits.
13. Study of SMPS.
14. Study of multiplexer and demultiplexer/decoders.

LIST OF SIMULATION EXPERIMENTS USING SPICE:

1. Simulation of Active low-pass, High-pass and band-pass filters using Op-amp.
2. Simulation of Astable and Monostable multivibrators using NE555 Timer.
3. Simulation of A/ D converter.
4. Simulation of Analog multiplier.

TOTAL PERIODS:60

OUTCOMES:

On Completion of the course, the student should be able to,

- Design amplifiers, oscillators, D-A converters using operational amplifiers.
- Devise filter design using op-amp and obtain its frequency response.

- Analyze the working principle of PLL and explain the application of frequency multiplier.
- Evaluate the operation of DC power supply using ICs.
- Interpret the performance of filters, multivibrators, A/D converter and analog multiplier using SPICE.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

S.NO	NAME OF THE EQUIPMENT	REQUIRED
1.	CRO/DSO	15 Nos
2.	Signal Generator /Function Generators (2 MHz)	15 Nos
3.	Dual Regulated Power Supplies (0 – 30V)	15 Nos
4.	Digital Multimeter	10 Nos
5.	IC Tester	5 Nos
6.	Standalone desktops PC	15 Nos
7.	IC741, IC555, IC78XX, Transistors, Resistors, Capacitors, diodes, Zener diodes, Bread Boards, Transformers, wires, Power transistors, Potentiometer, A/D and D/A convertors, LEDs .	50 Nos

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	2	-	-	-	-	2	2	-	2	2	2	-	-
2	3	3	3	2	-	-	-	-	2	2	-	2	2	2	-	-
3	3	3	3	-	-	-	-	-	2	2	-	2	2	-	-	-
4	3	2	-	-		1	-	-	2	2	-	2	3	3	2	-
5	3	2	-	-	3	1	-	-	2	2	-	2	2	-	3	-

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1906406 CIRCUITS DESIGN AND SIMULATION LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

The student should be made:

- To gain hands on experience in designing electronic circuits.
- To learn simulation software used in circuit design.
- To understand the fundamental principles of amplifier circuits.
- To differentiate feedback amplifiers and oscillators.
- To evaluate the operation of multivibrators.

LIST OF EXPERIMENTS

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS:

1. Series and Shunt feedback amplifiers-Frequency response, Input and output impedance calculation.
2. RC Phase shift oscillator and Wien Bridge Oscillator.
3. Hartley Oscillator and Colpitts Oscillator.
4. Single Tuned Amplifier.
5. RC Integrator and Differentiator circuits.
6. Astable and Monostable multivibrators.
7. Clippers and Clampers.

SIMULATION USING SPICE (Using Transistor):

1. Tuned Collector Oscillator.
2. Twin -T Oscillator / Wein Bridge Oscillator.
3. Double and Stagger tuned Amplifiers.
4. Bistable Multivibrator.
5. Schmitt Trigger circuit with Predictable hysteresis.
6. Analysis of power Amplifiers.

TOTAL PERIODS: 60

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OUTCOMES:

On completion of this laboratory course, the student should be able to:

- Analyze various types of feedback amplifiers.
- Design oscillators.
- Develop single and double tuned amplifiers.
- Test the wave-shaping circuits.
- Simulate multivibrators using SPICE Tool.

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS / 3 STUDENTS PER EXPERIMENT:

S.NO	EQUIPMENTS	REQUIRED
1.	CRO (Min 30MHz)	15Nos
2.	Signal Generator /Function Generators (2 MHz)	15 Nos
3.	Dual Regulated Power Supplies (0 – 30V)	15 Nos
4.	Digital Multimeter	15 Nos
5.	Digital LCR Meter	2 Nos
6.	Standalone desktops PC	15 Nos
7.	Transistor/FET (BJT-NPN-PNP and NMOS/ PMOS)	50 Nos

Components and Accessories:

Transistors, Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers. SPICE Circuit Simulation Software: (any public domain or commercial software).

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	2	3	2	-	-	3	3	-	1	3	3	3	1
2	3	2	2	2	3	2	-	-	3	2	-	2	3	3	3	1
3	3	2	2	2	3	2	-	-	2	3	-	2	3	3	3	1
4	3	2	2	3	3	2	-	-	3	3	-	3	3	3	3	1
5	3	2	3	3	3	2	-	-	3	2	-	2	3	3	3	1

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1906002 DISCRETE-TIME SIGNAL PROCESSING

	L	T	P	C
	3	0	0	3

OBJECTIVES:

The students should be made to:

- To learn discrete Fourier transform, properties of DFT and its application to linear filtering.
- To understand the characteristics of digital filters, design digital IIR filters and apply these filters to filter undesirable signals in various frequency bands.
- To design digital FIR filters and apply these filters to filter undesirable signals in various frequency bands.
- To understand the effects of finite precision representation on digital filters.
- To impart knowledge about Programming in Digital Signal Processors.

UNIT-I: DISCRETE FOURIER TRANSFORM 9

Review of signals and systems, concept of frequency in discrete-time signals, summary of analysis & synthesis equations for FT & DTFT, frequency domain sampling, Discrete Fourier transform (DFT) - deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT), Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.

UNIT-II: INFINITE IMPULSE RESPONSE FILTERS 9

Characteristics of practical frequency selective filters. Characteristics of commonly used Analog filters - Butterworth filters, Chebyshev filters. Design of IIR filters from Analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Frequency transformation in the Analog domain. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT-III: FINITE IMPULSE RESPONSE FILTERS 9

Design of FIR filters - symmetric and Anti-symmetric FIR filters - design of linear phase FIR filters using Fourier series method - FIR filter design using windows (Rectangular, Hamming and Hanning window), Frequency sampling method. FIR filter structures - linear phase structure, direct form realizations.

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UNIT-IV: FINITE WORD LENGTH EFFECTS 9

Fixed point and floating point number representation - ADC - quantization - truncation and rounding - quantization noise - input / output quantization - coefficient quantization error - product quantization error - overflow error - limit cycle oscillations due to product quantization and summation - scaling to prevent overflow.

UNIT-V: INTRODUCTION TO DIGITAL SIGNAL PROCESSORS 9

DSP functionalities - circular buffering – DSP architecture – Fixed and Floating point architecture principles – Programming – Application examples.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply DFT for the analysis of Digital Signals and Systems.
- Design IIR filters.
- Design FIR filters
- Characterize the effects of finite precision representation on digital filters.
- Apply Programming concepts in Digital Signal Processors.

TEXT BOOKS:

1. John G. Proakis & Dimitris G.Manolakis, "Digital Signal Processing -Principles, Algorithms & Applications", Fourth Edition, Pearson Education / Prentice Hall, 2016.
2. A. V. Oppenheim, R.W. Schafer and J.R. Buck, "Discrete-Time Signal Processing", 8^{th} Indian Reprint, Pearson, 2014.

REFERENCE BOOKS:

1. Emmanuel C. Ifeachor & Barrie. W. Jervis, "Digital Signal Processing", Second Edition, Pearson Education / Prentice Hall, 2012.
2. Sanjit K. Mitra, "Digital Signal Processing - A Computer Based Approach", Tata Mc Graw Hill, 2017.
3. Andreas Antoniou, "Digital Signal Processing", Tata Mc Graw Hill, 2016.

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	2	1	1	-	-	-	-	-	-	-	1	3	-	-	-
2	3	2	3	2	-	3	3	3	2	2	-	1	3	-	-	-
3	3	2	1	2	-	-	-	2	-	1	-	2	3	2	-	-
4	3	3	3	3	-	3	3	3	2	2	-	2	3	-	-	3
5	3	-	2	2	-	3	3	2	3	3	-	2	2	2	-	3

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1906501 **DIGITAL COMMUNICATION** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the basic principles of information theory and source coding techniques.
- To study the different waveform coding schemes.
- To explore the various baseband transmission schemes.
- To analyze the Band pass signaling schemes in digital communicaiton.
- To acquire knowledge in the fundamentals of channel coding.

UNIT - I: INFORMATION THEORY 9

Discrete Memoryless source, Information, Entropy, Mutual Information – Discrete Memoryless channels – Binary Symmetric Channel, Channel Capacity – Hartley – Shannon law – Source coding theorem – Shannon – Fano & Huffman codes.

UNIT - II: WAVEFORM CODING AND REPRESENTATION 9

Prediction filtering and DPCM – Delta Modulation – ADPCM & ADM principles-Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ – Bipolar NRZ – Manchester – HDBP.

UNIT - III: BASEBAND TRANSMISSION AND RECEPTION 9

ISI – Nyquist criterion for distortion less transmission – Pulse shaping – Correlative coding – Eye pattern – Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization.

UNIT - IV: DIGITAL MODULATION SCHEME 9

Geometric Representation of signals – Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK – QAM – Carrier Synchronization – Structure of Non-coherent Receivers – Principle of DPSK – MSK – Gaussian MSK.

UNIT - V: ERROR CONTROL CODING 9

Channel coding theorem – Linear Block codes – Hamming codes – Cyclic codes – Convolutional codes – Viterbi Decoder.

TOTAL PERIODS: 45

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OUTCOMES:

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

- Apply the basic principles of Information theory in digital communication.
- Design and assess waveform coding schemes.
- Analyze the performance of Baseband Transmission schemes.
- Apply the concept of Digital Modulation techniques in various application.
- Develop an error control system with appropriate coding techniques.

TEXT BOOKS:

1. S. Haykin, "Digital Communications", John Wiley, 2006
2. B.P.Lathi, "Modern Digital and Analog Communication Systems" 3rd Edition, Oxford University Press 2007.

REFERENCE BOOKS:

1. B. Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition, Pearson Education, 2009
2. B.P.Lathi, "Modern Digital and Analog Communication Systems" 3rd Edition, Oxford University Press 2007.
3. H P Hsu, Schaum Outline Series - "Analog and Digital Communications", TMH 2006
4. J.G Proakis, "Digital Communication", 4th Edition, Tata Mc Graw Hill Company, 2001.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	**PO**												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	3	3	2	-	-	2	2	-	-	-	2	2	-	-	-
2	3	2	3	-	-	-	-	-	-	-	-	2	3	-	-	-
3	3	2	2	-	-	-	2	2	-	-	-	2	2	2	-	-
4	3	3	2	-	-	-	-	-	-	-	-	2	3	3	-	-
5	3	3	3	3	-	-	2	2	-	-	-	2	2	2	-	-

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1906502 **COMMUNICATION NETWORKS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the division of network functionalities into layers.
- To make students to get familiarized with different protocols and network components.
- To be familiar with the components required to build different types of networks.
- To expose to the required functionality at each layer for the given application.
- To learn the flow control and congestion control algorithms in computer communication networks.

UNIT - I: FUNDAMENTALS & LINK LAYER 9

Overview of Data Communications- Networks – Building Network and its types– Overview of Internet - Protocol Layering - OSI Mode – Physical Layer – Overview of Data and Signals - introduction to Data Link Layer - Link layer Addressing- Error Detection and Correction.

UNIT - II: MEDIA ACCESS & INTERNETWORKING 9

Overview of Data link Control and Media access control - Ethernet (802.3) - Wireless LANs – Available Protocols – Bluetooth – Bluetooth Low Energy – WiFi – Low PAN–Zigbee - Network layer services – Packet Switching.

UNIT - III: LOGICAL ADDRESSING AND ROUTING 9

Logical addressing: IPv4, IPv6 addresses, Internet Protocol: IPv4, IPv6 - Address mapping –DHCP, ICMP, IGMP, Routing - Unicast Routing – Algorithms – Protocols – Multicast Routing and its basics – Overview of Intradomain and interdomain protocols.

UNIT - IV: TRANSPORT LAYER 9

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements.

UNIT - V: APPLICATION LAYER 9

Application Layer Paradigms – Client Server Programming – World Wide Web and HTTP - DNS- -Electronic Mail (SMTP, POP3, IMAP, MIME) – Introduction to Peer to Peer Networks – Need for Cryptography and Network Security – Firewalls.

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TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Identify the components required to build different types of networks.
- Choose the required functionality at each layer for given application.
- Recognize IEEE standard employed in computer networking.
- Trace the flow of information from one node to another node in the network.
- Explain the functions of Application layer paradigms and Protocols.

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data communication and Networking", Fifth Edition, Tata McGraw – Hill, 2013.
2. James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Seventh Edition, Pearson Education, 2016.

REFERENCE BOOKS:

1. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2nd Edition, 2014.
2. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", Mc Graw Hill Publisher, 2011.
3. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers, 2011.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	2	1	-	1	1	-	-	-	-	2	2	1	-	-
2	1	2	2	1	-	1	1	-	-	-	-	2	2	1	-	-
3	1	2	2	1	-	1	1	3	-	-	-	2	2	1	-	-
4	1	2	2	1	-	1	1	-	-	-	-	2	2	1	-	-
5	1	2	2	1	-	1	1	3	-	-	-	2	2	1	-	-

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1906503 **TRANSMISSION LINES AND RF SYSTEMS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the various types of transmission lines and its characteristics.
- To explore the nature of high frequency line, power and Impedance measurements.
- To impart technical knowledge in impedance matching using smith chart.
- To comprehend passive filters and basic knowledge of active RF components.
- To analyze the RF system transceiver design.

UNIT – I: TRANSMISSION LINE THEORY 9

General Theory of Transmission Lines - The Transmission Line - General Solution - The Infinite line - Wavelength, Velocity of Propagation - Waveform Distortion - The Distortion-Less Line - Loading and different methods of loading - Line not terminated in Z0 - Reflection coefficient - Calculation of current, voltage, power delivered and efficiency of transmission - Input and Transfer impedance - Open and Short Circuited Lines - Reflection Factor and Reflection Loss.

UNIT – II: HIGH FREQUENCY TRANSMISSION LINES 9

Transmission line equations at radio frequencies - Line of Zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and Short Circuited Lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.

UNIT – III: IMPEDANCE MATCHING IN HIGH FREQUENCY LINES 9

Impedance matching: Quarter wave transformer - Impedance matching by stubs - Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart - Single and double stub matching using Smith chart.

UNIT – IV: WAVEGUIDES 9

General Wave behaviour along uniform guiding structures – Transverse Electromagnetic Waves, Transverse Magnetic Waves, Transverse Electric Waves – TM and TE Waves between parallel plates. Field Equations in rectangular waveguides, TM and TE waves in rectangular waveguides, Bessel Functions, TM and TE waves in Circular waveguides, Excitation of Modes, Cavity Resonators.

UNIT – V: RF SYSTEM DESIGN CONCEPTS **9**

Active RF components: Semiconductor basics in RF, Bipolar junction transistors, RF field effect transistors, High electron mobility transistors Basic concepts of RF design, Mixers, Low noise amplifiers, Voltage control oscillators, Power amplifiers, transducer power gain and Stability considerations.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Explain the characteristics of transmission lines and its losses.
- Describe the standing wave ratio and input impedance in high frequency transmission lines.
- Analyze impedance matching by stubs using smith charts.
- Exhibit the characteristics of TE and TM waves.
- Explore the behaviour of a RF transceiver system for wireless communication.

TEXT BOOKS:

1. John D Ryder, "Networks, lines and fields", 2nd Edition, Prentice Hall India, 2015.
2. Mathew M. Radmanesh, "Radio Frequency &Microwave Electronics", Pearson Education Asia, Second Edition, 2002.

REFERENCE BOOKS:

1. Reinhold Ludwig and Powel Bretchko, "RF Circuit Design – Theory and Applications", Pearson Education Asia, First Edition,2001.
2. D. K. Misra, "Radio Frequency and Microwave Communication Circuits- Analysis and Design", John Wiley & Sons, 2004.
3. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems" Prentice Hall of India, 2006.
4. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines", Pearson Education, First edition 2005.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	3	2	2	-	-	-	-	-	-	-	2	3	1	-	-
2	3	2	2	1	-	-	-	-	-	-	-	2	3	2	-	-
3	3	3	3	3	-	-	-	-	-	-	-	2	3	3	-	-
4	3	2	2	2	-	-	-	-	-	-	-	2	3	1	-	-
5	3	3	3	2	-	-	-	-	-	-	-	2	3	3	-	-

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1906003 **DIGITAL SIGNAL PROCESSING LABORATORY**

L	T	P	C
0	0	4	2

OBJECTIVES:

The student should be made:

- To perform basic signal processing operations such as Linear Convolution, Circular Convolution, Auto Correlation, Cross Correlation and Frequency analysis in MATLAB.
- To implement FIR and IIR filters in MATLAB and DSP Processor.
- To study the architecture of DSP processor.
- To Perform MAC operation using various addressing modes and Generation of various signals and random noise.
- To design a DSP system to demonstrate the Multi-rate and Adaptive signal processing concepts.

LIST OF EXPERIMENTS:

MATLAB / EQUIVALENT SOFTWARE PACKAGE

1. Generation of elementary Discrete-Time sequences.
2. Linear and Circular convolutions.
3. Auto correlation and Cross Correlation.
4. Frequency Analysis using DFT.
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrates the filtering operation.
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.

DSP PROCESSOR BASED IMPLEMENTATION

1. Study of architecture of Digital Signal Processor.
2. Perform MAC operation using various addressing modes.
3. Generation of various signals and random noise.
4. Design and demonstration of FIR Filter for Low pass, High pass, Band pass and Band stop filtering.
5. Design and demonstration of Butter worth and Chebyshev IIR Filters for Low pass, High pass, Band pass and Band stop filtering.
6. Implement an Up-sampling and Down-sampling operation in DSP Processor.

OUTCOMES:

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

- Carryout basic signal processing operations.
- Demonstrate their abilities towards MATLAB based implementation of various DSP systems.

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- Analyze the architecture of a DSP Processor.
- Formulate and Implement the FIR and IIR Filters in DSP Processor for performing filtering operation over real-time signals.
- Design a DSP system for various applications of DSP.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

S.NO	Description of Equipment	Quantity Required
1	PCs with Fixed / Floating point DSP Processors (Kit / Add-on Cards)	15 Units (2 students per system)
2	**List of software required:** MATLAB with Simulink and Signal Processing Tool Box	10 Users License
3	Function Generators (1MHz)	15
4	CRO (20MHz)	15

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	2	1	1	1	-	-	2	2	1	1	1	2	-	-	-
2	2	2	2	2	3	-	2	2	2	-	3	1	3	-	2	3
3	3	2	1	2	-	-	-	2	2	1	3	-	2	2	2	-
4	2	2	2	3	-	-	-	2	2	2	3	-	2	-	2	2
5	3	-	2	2	3	-	-	2	2	3	3	2	2	2	3	3

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1906508 COMMUNICATION SYSTEMS AND NETWORKS LABORATORY **L T P C**

0 0 4 2

OBJECTIVES:

The student should be able to:

- Implement the Analog and Digital Modulation schemes.
- Simulate Digital Modulation schemes and Error Control Techniques.
- Implement the different protocols in communication network.
- Familiarize with IP Configuration in a network.
- Analyse the various routing algorithms.

LIST OF EXPERIMENTS:

1. AM Modulator and Demodulator, FM Modulator and Demodulator.
2. Pulse Code Modulation and Demodulation.
3. Delta Modulation and Demodulation.
4. Line coding schemes.
5. Simulation of ASK, FSK, BPSK,DPSK, QPSK and QAM generation schemes.
6. Simulation of Error control techniques.
7. Implementation of Error Detection / Error Correction Techniques.
8. Implementation of Flow control Algorithms.
9. Implementation of IP address configuration and Commands such as ping, Trace route, ns lookup.
10. To create scenario and study the performance of network with CSMA / CA protocol.

    and compare with CSMA/CD protocols.
11. Network Topology - Star, Bus, Ring.
12. Implementation of distance vector and Link state routing algorithm.

TOTAL PERIODS: 60

OUTCOMES:

On completion of this laboratory course, the student would be able to,

- Simulate & validate the various functional modules of a communication system
- Apply various Error coding schemes & demonstrate their capabilities towards the improvement of the noise performance of communication system
- Implement the different networking protocols.
- Configure a network using socket programming.
- Implement the various routing algorithms.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

S.NO	NAME OF THE EQUIPMENT	REQUIRED
1.	Kits for AM, FM, PCM, DM and Line Coding Schemes	5 Nos
2.	CROs/DSOs, Function Generators	15 Nos.
3.	C / Python / Java / Equivalent Compiler	30 User
4.	MATLAB Software	30 User
5.	Standard LAN Trainer Kits	4 Nos
6.	Network Simulator like NS2/NS3/Glomosim/OPNET	30 Nos
7.	Standalone Desktops	30 Nos

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	-	3	-	-	-	3	2	-	2	2	2	3	-
2	3	3	2	-	3	-	-	2	3	2	-	2	2	2	3	-
3	3	3	2	-	3	-	-	-	3	2	-	2	2	2	3	-
4	3	3	2	3	3	-	-	2	3	2	-	2	3	2	3	-
5	3	2	2	-	3	2	2	2	3	2	-	2	2	2	3	-

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1919002 **PROFESSIONAL COMMUNICATION** **L T P C 0 0 2 1**

OBJECTIVES

The course aims to

- Enhance the Employability and Career Skills of students.
- Orient the students towards grooming as a professional.
- To learn how to speak in Group discussions
- Make them employable Graduates and help them attend interviews successfully.
- Develop their confidence and help them express views clearly.

UNIT- I: General English for competitive Exams 6

English for competitive exams —General awareness of Current Affairs – multiple choice – Cloze – Vocabulary Structure.

UNIT- II: Mechanics of Interpersonal Communication 6

Introduction to soft skills - Interpersonal communication - Introducing oneself to the audience –– answering questions – writing a message – memo –mail – asking for comments – giving information – agreeing to requests – apologizing – Complaining – Business proposal – short report – summarizing.

UNIT- III: Basics of Group Discussion 6

Introduction to Group Discussion— participating in group discussions –-– questioning and clarifying –GD strategies –monologues – dialogues – discussions.

UNIT- IV: Fundamentals of Interview Skills 6

Interview etiquette –Portfolio development- attending job interviews–FAQs related to job interviews- Interview types –expressing opinions – present circumstances - past experiences – future plans

UNIT- V: Specific skills for Career advancement 6

Recognizing differences between groups and teams - networking professionally- respecting social protocols- understanding career management- developing a long- term career plan-making career changes. – organizing a larger unit of discourse – expressing and justifying opinions – negotiating – collaborating – disagreeing – speculating – decision taking.

Total Periods: 30

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The lab course is offered as an **Employability Enhancement Course**

The course is offered as a **one credit** paper with an End Semester Examination.

OUTCOMES:

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

- Make effective presentations.
- Participate confidently in Group Discussions
- Attend job interviews and interacting in different situations.
- Write business reports, proposals and related correspondence.
- Develop adequate Soft Skills required for the workplace

REFERENCE BOOKS:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015

2. Interact English Lab Manual for Undergraduate Students, Orient Blackswan: Hyderabad, 2016.

3. E.Suresh Kumar Communication for Professional Success. Orient Blackswan: Hyderabad, 2015

4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014

5. S. Hariharan. Soft Skills. MJP Publishers: Chennai, 2010.

6. Successful Presentations: DVD and Student's Book. A video series teaching business communication skills for adult professionals by John Huges and Andrew Mallett- OUP 2012.

7. Goodheart-Willcox, "Professional Communication", First Edition , 2017. Online test book

8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 edition, 2015

9. English for success in Competitive exams. Philip Sunil Solomon – OUP 2009.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	3	3	-	-	-	-	3	-	1	2	1	1	2
CO2	3	2	2	2	2	-	3	-	-	2	-	1	2	1	1	2
CO3	3	2	-	3	-	-	-	-	-	3	-	1	2	-	-	-
CO4	3	3	-	-	-	-	3	-	-	3	-	1	2	1	1	2
CO5	3	2	3	-	-	-	-	-	-	3	-	1	2	1	1	2

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1906601 MICROPROCESSORS AND MICROCONTROLLERS

	L	T	P	C
	3	0	0	3

OBJECTIVES:

The student should be made:

- To understand the Architecture of 8086 microprocessor.
- To learn the design aspects of I/O and Memory Interfacing circuits.
- To interface microprocessors with supporting chips.
- To study the Architecture of 8051 microcontroller.
- To design a microcontroller based system.

UNIT - I: THE 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture-Register & Memory Organization – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT - II: 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

UNIT - III: I/O INTERFACING 9

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

UNIT - IV: MICROCONTROLLER 9

Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes -Timers - Serial Port - Interrupts - Assembly language programming.

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UNIT - V: INTERFACING MICROCONTROLLER 9

LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor, Traffic Light Control and Waveform generation - Comparison of Microprocessor, Microcontroller, PIC and ARM processors.

TOTAL PERIODS: 45

OUTCOMES:

On completion of the course, the students should be able to:

- Execute programs based on 8086 microprocessor.
- Establish Coupled communication and bus interfacing.
- Design Memory Interfacing circuits.
- Explore and design the interface I/O circuits.
- Formulate and implement 8051 microcontroller based systems.

TEXT BOOKS:

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.

REFERENCE BOOKS:

1. DoughlasV.Hall, “Microprocessors and Interfacing, Programming and Hardware”, TMH, 2012.
2. A.K.Ray, K.M.Bhurchandi, "Advanced Microprocessors and Peripherals", 3rd edition, Tata McGraw Hill, 2012.
3. Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.
4. Soumitra Kumar Mandal, “Microprocessor and Microcontroller Architecture, Programming and Interfacing using 8085, 8086, 8051”, Kindle Edition, McGraw Hill Edu, 2013.
5. Sunil Mathur & Jeebananda Panda, “Microprocessor and Microcontrollers”, PHI Learning Pvt., Ltd., 2016.

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	2	1	3	1	-	2	-	-	-	2	2	1	3	-
CO2	2	2	2	1	-	-	-	2	-	-	-	2	2	1	3	-
CO3	2	1	2	1	3	1	-	2	-	-	-	2	2	1	3	-
CO4	2	1	2	1	3	1	-	2	-	-	-	2	2	1	3	-
CO5	2	1	2	3	3	1	-	2	-	-	-	2	2	1	3	-

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1906005 **VLSI DESIGN** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the fundamentals of CMOS circuits and its characteristics.
- To learn the design and realization of combinational digital circuits.
- To design and realize the sequential digital circuits.
- To examine the Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology.
- To explore the different FPGA architectures and testability of VLSI circuits.

UNIT – I: INTRODUCTION TO MOS TRANSISTOR 9

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

UNIT – II: COMBINATIONAL MOS LOGIC CIRCUITS 9

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

UNIT – III: SEQUENTIAL CIRCUIT DESIGN 9

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues: Timing Classification of Digital System, Synchronous Design.

UNIT – IV: DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, Power and speed trade-offs, Case Study: Design as a trade-off. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

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UNIT – V: IMPLEMENTATION STRATEGIES AND TESTING 9

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. ASIC design flow, Need for Testing, Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

TOTAL PERIODS:45

OUTCOMES:

On completion of the course, the student should be able to,

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

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson, 2017.

2. Jan M. Rabaey,Anantha Chandrakasan, Borivoje. Nikolic,"Digital Integrated Circuits:A Design perspective", Second Edition , Pearson , 2016.

REFERENCE BOOKS:

1. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997.

2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim, "CMOS Digital Integrated Circuits:Analysis & Design",4th edition McGraw Hill Education,2013.

3. Wayne Wolf, "Modern VLSI Design: System On Chip", Pearson Education, 2007.

4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	-	-	-	-	-	-	-	-	-	2	2	-	-	-
2	3	3	3	2	-	-	-	2	-	-	-	2	3	-	-	-
3	3	3	3	2	-	-	-	-	-	-	-	2	3	-	-	-
4	3	3	3	2	3	1	2	2	-	-	-	2	3	2	1	-
5	3	2	2	1	3	1	2	2	-	-	-	2	2	2	1	-

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1906008 EMBEDDED AND REAL TIME SYSTEMS

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	3	0	0	3

OBJECTIVES:

The student should be made to:

- Understand the concepts of embedded system design and analysis.
- Learn the architecture and programming of ARM processor.
- Expose to the basic concepts of embedded programming.
- Explore the real time operating systems.
- Acquire knowledge about the concepts of operating systems.

UNIT - I: INTRODUCTION TO EMBEDDED SYSTEM DESIGN 9

Complex systems and microprocessors – Embedded system design process-Design example: Model train controller – Design methodologies – Design flows – Requirement Analysis – Specification – System analysis and architecture design – Quality Assurance techniques – Designing with computing platforms – consumer electronics architecture – platform – level performance analysis.

UNIT - II: ARM PROCESSOR AND PERIPHERALS 9

ARM Architecture Versions – ARM Architecture – Instruction Set – Stacks and Subroutines – Features of the LPC 214X Family – Peripherals – The Timer Unit – Pulse Width Modulation Unit – UART – Block Diagram of ARM9 and ARM Cortex M3 MCU.

UNIT - III: EMBEDDED PROGRAMMING 9

Components for embedded programs – Models of programs – Assembly, linking and loading – compilation techniques – Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size – Program validation and testing.

UNIT - IV: REAL TIME SYSTEMS 9

Structure of a Real Time System – Estimating program run times –Task Assignment and Scheduling – Fault Tolerance Techniques – Reliability, Evaluation – Clock Synchronisation.

UNIT - V: PROCESSES AND OPERATING SYSTEMS 9

Introduction – Multiple tasks and multiple processes – Multirate systems – Pre-emptive real-time operating systems – Priority based scheduling – Interprocess communication mechanisms – Evaluating operating system performance – power optimization strategies

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for processes – Example Real time operating systems – POSIX-Windows CE. – Distributed embedded systems – MPSoCs and shared memory multiprocessors. – Design Example - Audio player, Engine control unit – Video accelerator.

TOTAL PERIODS: 45

OUTCOMES:

On completion of course the student should be able to:

- Describe the architecture and programming of ARM processor.
- Outline the concepts of embedded systems.
- Explain the basic concepts of real time Operating system design.
- Use the system design techniques to develop software for embedded systems.
- Model real-time applications using embedded-system concepts.

TEXT BOOKS:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design" ,Third Edition, Morgan Kaufmann Publisher (An imprint from Elsevier), 2012.
2. Jane W.S.Liu, "Real Time Systems" ,Pearson Education, Third Indian Reprint, 2003.

REFERENCE BOOKS:

1. Lyla B.Das, "Embedded Systems: An Integrated Approach" ,Pearson Education, 2013.
2. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", Third Edition Cengage Learning, 2012.
3. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, Addison-Wesley Professional, 2007.
4. Raymond J.A. Buhr, Donald L.Bailey, "An Introduction to Real-Time Systems- From Design to Networking with C/C++", Prentice Hall, 1999.
5. C.M. Krishna, Kang G. Shin, "Real-Time Systems", International Editions, Mc Graw Hill 1997.
6. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming", Dream Tech Press, 2005.
7. Sriram V Iyer, Pankaj Gupta, "Embedded Real Time Systems Programming", Tata Mc Graw Hill, 2004.

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	2	3	-	-	-	-	-	-	2	2	2	-	2	-
2	1	2	2	3	-	-	-	-	-	-	2	2	2	-	2	-
3	1	2	2	3	-	-	-	-	-	-	2	2	2	-	2	-
4	1	2	2	3	-	2	-	2	-	-	2	2	2	-	2	-
5	1	2	2	3	3	2	2	2	-	-	2	2	2	2	2	-

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1906602 **WIRELESS NETWORKS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the concept about Wireless networks, protocol stack and standards.
- To analyze the network layer solutions for Wireless networks.
- To examine the fundamentals of 3G Services, its protocols and applications.
- To know the concepts of internetworking of WLAN and WWAN.
- To learn about evolution of 4G Networks, its architecture and applications.

UNIT – I: WIRELESS LAN 9

Introduction-WLAN technologies: - IEEE802.11: System architecture, Protocol architecture, 802.11b, 802.11a – Hiper LAN: WATM, BRAN, HiperLAN2 – Bluetooth: Architecture, WPAN – IEEE 802.15.4, Wireless USB, Zigbee, 6LoWPAN, Wireless HART.

UNIT – II: MOBILE NETWORK LAYER 9

Introduction - Mobile IP: IP packet delivery, Agent discovery, Tunneling and encapsulation, IPV6-Network layer in the internet- Mobile IP session initiation protocol - Mobile ad-hoc network: Routing: Destination Sequence distance vector, IoT: CoAP.

UNIT – III: 3G OVERVIEW 9

Overview of UTMS Terrestrial Radio access network-UMTS Core network Architecture: 3GPP Architecture, User equipment, UMTS Interfaces, Mobility Management for UMTS Network, CDMA2000 overview- Radio and Network components, Network structure, Radio Network, TD-CDMA, TD – SCDMA.

UNIT - IV: INTERNETWORKING BETWEEN WLANS AND WWANS 9

Internetworking objectives and requirements, Schemes to connect WLANS and 3G Networks, Session Mobility, Internetworking Architecture for WLAN and GPRS, System Description, Local Multipoint Distribution Service, Multichannel Multipoint Distribution System.

UNIT – V: 4G & BEYOND 9

Introduction – 4G vision – 4G features and challenges - Step towards 4G Networks - Why Integration, Benefits of Integration Applications of 4G – 4G Technologies: Multicarrier Modulation, Smart antenna techniques, IMS Architecture, LTE, Advanced Broadband Wireless Access and Services, MVNO.

TOTAL PERIODS: 45

OUTCOMES:

After studying this course, the student should be able to,

- Understand with the latest 3G/4G networks and its architecture.
- Design and implement wireless network environment for any application using latest wireless protocols and standards.
- Ability to select the suitable network depending on the availability and requirement.
- Implement the type of applications for smart phones and mobile devices with latest network strategies.
- Identify the software tools appropriately for the specific application.

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communications”, Second Edition, Pearson Education 2012.
2. Vijay Garg, “Wireless Communications and networking”, First Edition, Elsevier 2007.

REFERENCE BOOKS:

1. Erik Dahlman, Stefan Parkvall, Johan Skold and Per Beming, "3G Evolution HSPA and LTE for Mobile Broadband”, Second Edition, Academic Press, 2008.
2. Anurag Kumar, D.Manjunath, Joy kuri, “Wireless Networking”, First Edition, Elsevier 2011.
3. Simon Haykin, Michael Moher, David Koilpillai, “Modern Wireless Communications”, First Edition, Pearson Education 2013.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	2	3	1	-	-	-	-	-	-	-	2	1	-	-	-
2	2	2	3	1	-	-	-	-	-	-	-	2	2	2	2	-
3	1	2	3	1	-	-	-	-	-	-	-	2	2	2	2	-
4	3	2	3	1	-	-	-	-	-	-	-	2	2	2	2	-
5	3	2	3	1	-	-	-	-	-	-	-	2	1	2	2	-

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1906605 MICROCONTROLLERS AND EMBEDDED LABORATORY **L T P C**
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OBJECTIVES:

The student should be made to:

- Write Assembly Language Program (ALP) for arithmetic and logical operations in 8086 and 8051.
- Differentiate Serial and Parallel Interface.
- Understand the working of ARM Processor and study the interrupt performance.
- Enumerate programs to interface memory, I/O's with processor.
- Explore the concepts of Hardware of various microcontrollers to enable Programming and Interfacing of microcontroller.

LIST OF EXPERIMENTS: 8086 Programs using kits and MASM

1. Basic arithmetic and Logical operations.
2. Move a data block without overlap.
3. Code conversion, decimal arithmetic and Matrix operations.
4. String manipulations, sorting and searching.
5. Password checking, Print RAM size and system date.

LIST OF EXPERIMENTS: Peripherals and Interfacing Experiments using 8086 and ARM – 7 Processor.

6. Interfacing Traffic light controller.
7. Interfacing Stepper motor and Temperature sensor.
8. Implementing Zigbee protocol with ARM.
9. Interfacing Key board and LCD.
10. Interfacing LED and PWM.
11. Interfacing EPROM and Interrupt.
12. Analyze Serial interface and Parallel interface.
13. Interfacing ADC and DAC and Waveform Generation.

LIST OF EXPERIMENTS: 8051 Experiments using kit and MASM.

14. Program Basic arithmetic and Logical operations.
15. Implement Square and Cube program and Find 2's complement of a number.

TOTAL PERIODS: 60

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OUTCOMES:

On completion of this laboratory course, the student would be able to,

- Write ALP Programs for Arithmetic operations and Logical operations.
- Express the programming logics for code conversion and acquire knowledge on ADC and DAC.
- Interface different I/O's with processor and Generate waveforms using 8086 and ARM processors.
- Execute microcontroller programs in 8051.
- Formulate a mini Project using Embedded System

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

S.NO	NAME OF THE EQUIPMENT	REQUIRED
1.	Intel Desktop Systems with MASM	10 No's
2.	Embedded ARM-7 Processor Kit	10 No's
3.	8086 Microprocessor Trainer with Power Supply	10 No's
4.	8051 Micro Controller Trainer Kit with power supply	5 No's
5.	8255 Interface boards	3 No's
6.	8251 Interface boards	3 No's
7.	8259 Interface boards	3 No's
8.	8279 Keyboard / Display Interface boards	3 No's
9.	8254 timer/ counters, 8253 Timer	3 No's
10.	ADC and DAC cards	3 No's
11.	AC & DC motor with Controllers	2 No's
12.	Traffic Light Control Systems	3 No's
13.	Stepper Motor	3 No's
14.	CRO (Cathode Ray Oscilloscope - 20 MHz)	2 No's
15.	Zigbee Module (Transmitter and Receiver)	3 No's

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	2	-	3	-	-	-	2	2	-	3	2	2	3	-
CO2	2	-	3	-	3	-	-	-	2	2	-	2	2	-	3	-
CO3	1	2	3	-	3	-	-	-	1	2	-	2	2	-	3	-
CO4	1	2	3	-	3	-	-	-	2	2	-	2	2	-	3	-
CO5	1	2	3	2	3	2	2	2	2	2	-	2	2	2	3	-

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1906606 **VLSI DESIGN LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

The student should be made:

- To learn Hardware Descriptive Language (Verilog/VHDL).
- To learn the fundamental principles of VLSI circuit design in analog domain.
- To learn the fundamental principles of VLSI circuit design in digital domain.
- To familiarize fusing of logical modules on FPGAs.
- To provide hands on design experience with professional design (EDA) platforms.

LIST OF EXPERIMENTS: Digital System Design using HDL & FPGA

1. Design an Adder (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
2. Design a Multiplier (4 Bit Min) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
3. Design an ALU using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
4. Design of Code Converters using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
5. Design a Universal Shift Register using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
6. Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.
7. Design Memories using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA.

Compare pre synthesis and post synthesis simulation for experiments 1 to 7. Requirements: Xilinx ISE/Altera Quartus/ equivalent EDA Tools along with Xilinx/Altera/equivalent FPGA Boards.

LIST OF EXPERIMENTS: Digital Circuit Design

8. Design and simulate a CMOS inverter using digital flow
9. Design and simulate a CMOS Basic Gates & Flip-Flops
10. Design and simulate a 4-bit synchronous counter using a Flip-Flops

Manual/Automatic Layout Generation and Post Layout Extraction for experiments 8 to 10 . Analyze the power, area and timing for experiments 7 to 9 by performing Pre Layout and Post Layout Simulations.

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LIST OF EXPERIMENTS: Analog Circuit Design

11. Design and Simulate a CMOS Inverting Amplifier.
12. Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers.

Analyze the input impedance, output impedance, gain and bandwidth for experiments 11 and 12 by performing Schematic Simulations.

13. Design and simulate simple 5 transistor differential amplifier. Analyze Gain, Bandwidth and CMRR by performing Schematic Simulations.

Requirements: Cadence/Synopsis/ Mentor Graphics/Tanner/equivalent EDA Tools.

TOTAL PERIODS:60

OUTCOMES:

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

- Write HDL code for analog integrated circuit.
- Design HDL code for basic as well as advanced digital integrated circuit.
- Import the logic modules into FPGA Boards
- Synthesize Place and Route the digital IPs
- Design, Simulate and Extract the layouts of Digital & Analog IC Blocks using EDA tools.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

S.NO	NAME OF THE EQUIPMENT	REQUIRED
1.	Xilinx ISE/Altera Quartus/ equivalent EDA Tools	10 user licence
2.	inx/Altera/equivalent FPGA Boards	10 Nos
3.	Cadence/Synopsis/ Mentor Graphics/Tanner/equivalent EDA Tools	10 user licence
4.	Personal Computer	30 Nos

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-
2	3	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
3	3	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
4	3	3	3	2	3	1	-	-	-	1	2	-	3	2	1	-
5	3	2	2	1	3	1	-	-	-	1	2	-	2	2	1	-

1906607 **MINI PROJECT** **L T P C**

0 0 4 2

OBJECTIVES:

The students should be made:

- To develop the ability to solve a specific problem in the domain based on their interest.
- To acquire knowledge and idea in the particular domain by the literature review.
- To find the successful solution of the problem identified.
- To demonstrate the implemented project.
- To prepare the documentation and present the model effectively to reach the social people.

Course Description:

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

TOTAL PERIODS: 60

OUTCOMES:

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

- Frame the problem solution.
- Explore the knowledge in the corresponding field of project.
- Compare the model with the existing system.
- Demonstrate the model designed for the solution.
- Publish the results obtained from the model.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	3	3	2	-	1	2	2	3	3	3	3	2	1	2
2	3	2	3	3	2	-	1	2	2	3	3	3	3	3	1	2
3	3	1	3	3	2	-	1	2	2	3	3	3	3	3	3	1
4	3	2	3	3	2	-	1	2	2	3	3	3	3	2	2	1
5	3	1	3	3	2	-	1	2	2	3	3	3	1	2	3	1

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1906701 ANTENNAS AND MICROWAVE ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To enable the student to understand the basic principles in antenna and microwave system.
- To enrich the student knowledge in radiation mechanisms of antenna and various antenna designs.
- To improve the student knowledge in the area of antenna arrays and applications.
- To enhance the student knowledge in the area of microwave components.
- To enable the student to understand the principles in microwave system design.

UNIT - I: INTRODUCTION TO MICROWAVE SYSTEMS AND ANTENNAS 9

Microwave frequency bands, Physical concept of radiation, Fields and Power radiated by an antenna, Antenna pattern characteristics, Antenna Gain and Efficiency, Antenna Noise Temperature, Impedance matching, Friis transmission equation and Radar range equation, Link budget and link margin, Noise characterization of a microwave receiver.

UNIT - II: RADIATION MECHANISMS AND DESIGN ASPECTS 9

Radiation mechanisms of Dipole/Monopole, Linear Wire, Loop and Slot antennas, Aperture antennas, Reflector antennas, Microstrip antennas and Frequency independent antennas, Wide Band Antennas, Design considerations and applications.

UNIT - III: ANTENNA ARRAYS AND APPLICATIONS 9

Two-element array, Array factor, Pattern multiplication, Uniformly spaced arrays with uniform and non-uniform excitation amplitudes, Concept of phased arrays, Frequency scanning arrays, Smart antennas.

UNIT - IV: PASSIVE AND ACTIVE MICROWAVE DEVICES 9

Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, Attenuator, Resonator, Principles of Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes, Microwave tubes: Klystron, TWT, Magnetron.

UNIT - V: MICROWAVE DESIGN PRINCIPLES **9**

Impedance transformation, Impedance matching, Microwave filter design, RF and Microwave amplifier design, Microwave power amplifier design, Low noise amplifier design, Microwave mixer design, Microwave oscillator design.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Apply the basic principles and evaluate antenna parameters and link power budgets.
- Design and assess the performance of various antennas.
- Design and evaluate the performance of several antenna arrays.
- Analyze microwave passive and active components.
- Design a microwave system for the given application specifications.

TEXT BOOKS:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, “Antennas and Wave Propagation”, Fifth Edition, Tata McGraw-Hill, 2017.
2. David M. Pozar, “Microwave Engineering”, Fourth Edition, Wiley India, 2012.

REFERENCE BOOKS:

1. Constantine A.Balanis, Antenna Theory Analysis and Design, Fourth edition, John Wiley India Pvt. Ltd., 2016.
2. S. Drabowitch, “Modern Antennas”, Second Edition, Springer Publications, 2007.
3. Reinhold Ludwig and Gene Bogdanov, “RF Circuit Design: Theory and Applications”, Pearson Education Inc., 2011.
4. R.E.Collin, “Foundations for Microwave Engineering”, Second edition, IEEE Press, 2001.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	-	-	2	-	-	-	-	-	-	2	-	-	-
2	3	3	2	-	-	-	-	-	-	-	-	-	2	-	-	-
3	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-	-
4	3	3	1	3	3	-	-	-	-	2	2	-	3	3	-	3
5	3	2	1	-	-		2	3	-	-	-	-	2	-	-	-

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1906702 **OPTICAL COMMUNICATION** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To analyze the optical fiber modes and configuration of optical fibers.
- To understand the transmission characteristics of optical fibers.
- To learn about the optical sources, detectors and transmission techniques.
- To explore the idea about optical fiber measurements and various coupling techniques.
- To enrich the knowledge about optical communication systems and networks.

UNIT – I: INTRODUCTION TO OPTICAL FIBERS 9

Introduction-General optical fiber communication system- Basic optical laws and definitions Optical modes and configurations -Mode analysis for optical propagation through fibers modes in planar wave guide-Modes in cylindrical optical fiber-Transverse electric and transverse magnetic modes- Fiber materials-Fiber fabrication techniques-Fiber optic cables classification of optical fiber-Single mode fiber-Graded index fiber .

UNIT – II: TRANSMISSION CHARACTERISTIC OF OPTICAL FIBER 9

Attenuation-Absorption-Scattering losses-Bending losses-Core and Cladding losses-Signal dispersion –Inter symbol interference and bandwidth-Intra model dispersion-Material dispersion- Waveguide dispersion-Polarization mode dispersion-Intermodal dispersion Optimization of single mode fiber-Characteristics of single mode fiber-R-I Profile cutoff wave length-Dispersion calculation-Mode field diameter.

UNIT – III: OPTICAL SOURCES AND DETECTORS 9

Sources: Intrinsic and extrinsic material-direct and indirect band gaps-LED-LED structures surface emitting LED-Edge emitting LED-Quantum efficiency and LED power-Light source materials-Modulation of LED-LASER diodes-Modes and threshold conditions-Rate equations-external quantum efficiency-Resonant frequencies-Structures and radiation patterns-Single mode laser-External modulation-Temperature effort. Detectors: PIN photo detector-Avalanche photo diodes-Photo detector noise-Noise sources-SNR-detector response time-Avalanche multiplication noise-Temperature effects comparisons of photo detectors.

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UNIT – IV: OPTICAL RECEIVER, MEASUREMENTS AND COUPLING 9

Fundamental receiver operation-Preamplifiers-Digital signal transmission-Error sources-Front end amplifiers-Digital receiver performance-Probability of error-Receiver sensitivity-Quantum limit. Optical power measurement-Attenuation measurement-Dispersion measurement- Fiber numerical Aperture Measurements- Fiber cut-off Wave length Measurements- Fiber diameter measurements-Source to Fiber Power Launching-Lensing Schemes for Coupling Management-Fiber to Fiber Joints-LED Coupling to Single Mode Fibers-Fiber Splicing Optical Fiber connectors.

UNIT – V: OPTICAL COMMUNICATION SYSTEMS AND NETWORKS 9

Elements of optical networks-SONET/SDH Optical Interfaces-SONET/SDH Rings and Networks-Optical ETHERNET-Soliton.-Optical network concepts - Optical network transmission modes, layers and protocols - Wavelength routing networks - Optical switching networks - Optical network deployment - Optical Ethernet .

TOTAL PERIODS:45

OUTCOMES:

After studying this course, the student should be able to,

- Examine the basic elements in optical fibers, different modes and configurations.
- Analyse the transmission characteristics associated with dispersion and polarization techniques.
- Design optical sources and detectors with their use in optical communication system.
- Construct fiber optic receiver systems, measurements and coupling techniques.
- Understand and Design communication systems and networks.

TEXT BOOKS:

1.P Chakrabarti, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited, 2016.

2.Gerd Keiser, "Optical Fiber Communication", McGraw Hill Education (India) Private Limited. Fifth Edition, Reprint 2013.

3. J.Senior, "Optical Communication, Principles and Practice", Prentice Hall of India, 3rd Edition, 2008.

REFERENCE BOOKS:

1.John M.Senior, "Optical fiber communication", Pearson Education, second edition,2007.

2. Rajiv Ramaswami, "Optical Networks", Second Edition, Elsevier, 2004.

3. J.Gower, "Optical Communication System", Prentice Hall of India, 2001.

4. Govind P. Agrawal, "Fiber-optic communication systems", third edition, John Wiley & sons, 2004.

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	2	–	2	–	–	–	–	-	2	3	3	-	-
2	3	3	3	2	-	2	–	–	–	–	-	2	3	3	-	-
3	3	3	2	2	–	2	–	–	–	–	-	2	3	3	-	-
4	3	3	2	2	-	2	–	–	–	–	-	2	3	3	-	-
5	3	3	2	3	-	2	–	–	–	-	-	2	2	-	-	-

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OBJECTIVES:

The student should be made:

- To analyze the characteristic of wireless channel.
- To understand the design of a cellular system.
- To examine the digital signaling techniques and multipath mitigation techniques.
- To learn the multipath mitigation techniques.
- To know the concepts of multiple antenna techniques.

UNIT – I: CELLULAR ARCHITECTURE 9

Multiple Access techniques - FDMA, TDMA, CDMA – Packet Radio, Capacity calculations– The Cellular concept- Frequency reuse – Channel assignment strategies, Hand off strategies, Interference and System Capacity –CCI & ACI. Trunking & Grade of service – Methods to improve Coverage and Capacity in cellular systems.

UNIT – II: WIRELESS CHANNELS 9

Mobile Radio Propagation: Large scale path loss – Free Space Propagation Model, Basic Propagation mechanisms-Reflection, Diffraction, Scattering. Path loss models- Outdoor and Indoor propagation models, Link Budget design ,Small scale path loss-Types of small scale fading – Fading effects due to Multipath time delay spread, Fading effects due to Multipath time Doppler spread.

UNIT – III: DIGITAL SIGNALING FOR FADING CHANNELS 9

Structure of a wireless communication link, Principles of Minimum Shift Keying, Gaussian Minimum Shift Keying modulation techniques. Modulation performance in fading and multipath channels, OFDM principle – Cyclic prefix, Windowing, PAPR.

UNIT – IV: MULTIPATH MITIGATION TECHNIQUES 9

Equalisation – Adaptive equalization, Linear, Non-Linear equalization -Zero forcing and LMS, RLS Algorithms. Diversity techniques – Micro and Macro diversity, Diversity combining techniques, Error probability in fading channels with diversity reception, Rake receiver.

UNIT – V: MULTIPLE ANTENNA TECHNIQUES 9

MIMO systems – Spatial multiplexing -System model -Pre-coding - Beam forming - Transmitter diversity, Receiver diversity- Channel state information-Capacity in fading and non-fading channels- Software defined antenna.

TOTAL PERIODS:45

OUTCOMES:

After studying this course, the student should be able to,

- Characterize wireless channels.
- Implement the signaling schemes for fading channels.
- Design a cellular system.
- Compare multipath mitigation techniques and their performance.
- Analyze the transmit/receive diversity and MIMO systems.

TEXT BOOKS:

1. Rappaport,T.S., “Wireless communications”, Pearson Education, Second Edition, 2010.
2. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.

REFERENCE BOOKS:

1. Andrea Goldsmith, “Wireless Communication”, Cambridge University Press, 2011
2. Van Nee, R. and Ramji Prasad, “OFDM for wireless multimedia communications”, Artech House, 2000.
3. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
4. Upena Dalal, “Wireless Communication”, Oxford University Press, 2009.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	-	-	-	-	-	-	-	3	-	-	-	-
2	2	2	3	3	-	-	-	-	-	-	-	2	2	1	2	-
3	2	2	2	1	-	2	-	-	-	-	-	3	2	-	2	-
4	2	1	3	3	-	2	-	-	-	-	-	3	2	-	2	-
5	3	3	2	3	-	-	-	-	-	-	-	2	-	1	-	-

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1906704 **DIGITAL IMAGE PROCESSING** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

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

UNIT – I: DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Types of Images: Monochrome and Color model, Chromatic diagram, Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models

UNIT – II: IMAGE ENHANCEMENT 9

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

UNIT – III: IMAGE RESTORATION 9

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

UNIT – IV: IMAGE SEGMENTATION 9

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

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UNIT – V: IMAGE COMPRESSION AND RECOGNITION 9

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

TOTAL PERIODS:45

OUTCOMES:

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

- Explain the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
- Apply various techniques of smoothing, sharpening and enhancement on images.
- Analyse the restoration concepts and filtering techniques.
- Explore the basics of segmentation, features extraction.
- Enumerate the compression and recognition methods.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	-	-	-	-	-	-	-	-	-	2	2	-	-	-
2	3	2	2	3	-	-	-	-	-	-	-	2	2	2	-	-
3	3	2	2	2	-	-	-	-	-	-	-	2	2	2	-	-
4	3	3	2	2	-	-	-	-	-	-	-	2	3	3	-	-
5	3	3	-	-	-	-	-	-	-	-	-	2	2	-	-	-

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1906708 ADVANCED COMMUNICATION LABORATORY L T P C

0 0 4 2

OBJECTIVES:

The student should be made to:

- Understand the working principle of optical sources, detector, fibers.
- Develop a conventional optical communication link.
- Measure and analyze the BER, Pulse broadening.
- Capture an experimental approach to digital wireless communication.
- Realize the actual communication waveforms that will be sent and received across wireless channel.

LIST OF OPTICAL EXPERIMENTS:

1. Measurement of connector, bending and fiber attenuation losses.
2. Calculation Numerical Aperture and Mode characteristics of fibers.
3. DC characteristics of LED and PIN Photo diode.
4. Fiber optic Analog and Digital Link Characterization - frequency response (Analog), eye diagram and BER (Digital).

LIST OF WIRELESS COMMUNICATION EXPERIMENTS:

5. Wireless Channel Simulation including fading and Doppler effects
6. Simulation of Channel Estimation, Synchronization & Equalization techniques.
7. Analyzing Impact of Pulse Shaping and Matched Filtering using Software Defined Radios.
8. OFDM Signal Transmission and Reception using Software Defined Radios.

LIST OF MICROWAVE EXPERIMENTS:

9. VSWR, Frequency, Wavelength and Impedance Measurement and Impedance Matching.
10. Characterization of Directional Couplers, Isolators, Circulators, E Plane Tee, H Plane Tee and Magic Tee.
11. Gunn Diode and Reflex klystron Characteristics.
12. Microwave IC – Filter Characteristics.

TOTAL PERIODS: 60

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OUTCOMES:

On completion of this lab course, the student would be able to,

- Analyze the performance of simple optical link by measurement of losses and analysing the mode characteristics of fiber.
- Investigate the characteristics of optical source and detectors.
- Examine the Eye Pattern, Pulse broadening of optical fiber and the impact on BER.
- Estimate the Wireless Channel Characteristics and analyse the performance of Wireless Communication System.
- Understand the intricacies in Microwave System design.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENTS PER EXPERIMENT:

S.NO	NAME OF THE EQUIPMENT	REQUIRED
1.	Trainer kit for carrying out LED and PIN diode characteristics, Digital multi meter, optical power meter.	2 Nos
2.	Trainer kit for determining the mode characteristics, losses in optical fiber.	2 Nos
3.	Trainer kit for analyzing Analog and Digital link performance, 2 Mbps PRBS Data source, 10 MHz signal generator, 20 MHz Digital storage Oscilloscope.	2 Nos
4.	Kit for measuring Numerical aperture and Attenuation of fiber.	2 Nos
5.	Advanced Optical fiber trainer kit for PC to PC communication, BER Measurement, Pulse broadening.	2 Nos
6.	MM/SM Glass and plastic fiber patch chords with ST/SC/E2000 connectors.	2 sets
7.	LEDs with ST / SC / E2000 receptacles – 650 / 850 nm.	2 sets
8.	PIN PDs with ST / SC / E2000 receptacles – 650 / 850 nm.	2 sets
9.	Digital Communications Teaching Bundle (LabVIEW / MATLAB / Equivalent software tools).	10 Users
10.	Transmit/receive pair of NI USRP-2920 transceivers (50 MHz to 2.2 GHz).	2 Nos

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	-	-	-	-	-	-	2	3	-	-	-	2	-	-	-
2	3	3	2	-	-	-	-	-	3	-	-	-	2	-	-	-
3	3	3	-	-	-	-	-	-	3	-	-	-	2	-	-	-
4	3	3	1	3	3	-	-	-	3	2	2	2	3	3	3	3
5	3	2	1	-	-	2	-	2	3	-	-	-	2	-	-	-

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1906709	PROJECT WORK – PHASE I	L T P C
		0 0 4 2

OBJECTIVES:

The Student should be able to

- Consolidate the literature search and formulate the problem for the project Work.
- Devise a solution for the problem identification.
- Design the project to meet specification using the modern tools.
- Construct and develop the project (Product) adhering to the norms and Professional ethics
- Contribute to the society as an individual or as a team.

OBJECTIVES:

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

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

TOTAL PERIODS: 60

OUTCOMES:

On Completion of the course the student should be able to:

- Apply the fundamental knowledge and skills in engineering and effectively formulate a project.
- Plan and manage the time effectively as a team.
- Orally present and demonstrate the product to peers, academics, general and industry community.
- Consider the business context and commercial positioning of designed devices or systems.
- Explore the knowledge for the ‘real world’ situations that a professional engineer can encounter.

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	2	3	3	-	3	2	3	3	3	3	-	3
2	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3
3	3	3	3	3	2	-	-	-	2	3	3	3	3	3	3	2
4	3	3	3	3	3	-	2	2	3	2	3	3	3	3	3	3
5	2	1	-	3	3	-	-	-	2	3	2	1	2	-	-	2

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1906710 **INTERNSHIP** **L T P C**

0 0 0 1

OBJECTIVES:

The student should be made to:

- Analyze a professional setting's strength and challenges.
- Communicate in a workplace environment in a clear and confident manner.
- Evaluate performance and accept feedback, in order to make changes as necessary.
- Articulate their experience and skills to potential employers.
- Identify and articulate next steps in their career trajectory.

The students may be allowed to arrange internship. In that case a student can take a letter from the placement/respective department and contact the company. The confirmation letter from the company has to be submitted in the placement / respective department.

Students will be associated with one faculty from respective department who will act as internal mentor. During six months duration, internal mentor will assess the student's performance twice. Final Evaluation of internship will be done jointly by the internal and company mentor.

Students will maintain the record of the work done in the industry and submit a report in the institute within one week of the start of the next semester. The certificate and the report have to be duly signed by a responsible official of the company.

The institute will arrange evaluation of the internship within 15 days of the start of the semester. The date of evaluation will be notified at least one week before the date of evaluation.

OUTCOMES:

The student should be able to:

- Apply the knowledge, skills, and experience to a work environment.
- Acquire new learning through challenging and meaningful activities.
- Build and maintain strong networking/mentoring relationships.
- Identify, clarify and/or confirm professional direction as it relates to the academic studies and future career path.
- Develop self-understanding, self-discipline, maturity and confidence.

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	1	1	2	2	2	2	2	2	2	2	1	1	2	2
2	2	1	1	1	2	2	2	2	2	2	2	2	1	1	2	2
3	2	-	-	-	2	2	2	2	2	2	2	2	-	2	2	2
4	2	-	-	-	2	2	2	2	2	2	2	2	-	2	2	2
5	2	-	-	-	2	2	2	2	2	2	2	2	-	2	2	2

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1906810 **PROJECT WORK – PHASE II** **L T P C**

0 0 12 6

OBJECTIVES:

- Have ability to consolidate the literature search and formulate the problem for the project Work.
- Devise a solution for the problem identification.
- Design the project to meet specification using the modern tools.
- Construct and develop the project (Product) adhering to the norms and Professional ethics
- Contribute to the society as an individual or as a team.

OBJECTIVES:

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

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

TOTAL PERIODS: 180

OUTCOMES:

The student should be able to:

- Use of fundamental knowledge and skills in engineering and apply it effectively on a project.
- Plan and manage the time effectively as a team.
- Orally present and demonstrate your product to peers, academics, general and industry community.
- Consider the business context and commercial positioning of designed devices or systems.
- Apply knowledge of the ‘real world’ situations that a professional engineer can encounter.

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	2	3	3	-	3	2	3	3	3	3	-	3
2	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3
3	3	3	3	3	2	-	-	-	2	3	3	3	3	3	3	2
4	3	3	3	3	3	-	2	2	3	2	3	3	3	3	3	3
5	2	1	-	3	3	-	-	-	2	3	2	1	2	-	-	2

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PROFESSIONAL ELECTIVES (PE)

SEMESTER V

PROFESSIONAL ELECTIVE-I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1906504	Sensor Technology	PE	3	3	0	0	3
2.	1906009	Medical Electronics	PE	3	3	0	0	3
3.	1904511	Operating Systems	PE	3	3	0	0	3
4.	1907002	Robotics and Automation	PE	3	3	0	0	3
5.	1921503	Nano Technology and Applications	PE	3	3	0	0	3

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1906504 SENSOR TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To introduce the basics of sensor classification and its measurements.
- To explain capacitive and inductive principle of sensing.
- To introduce different interfacing methods for sensors.
- To familiarize the different sensors and its applications.
- To understand the different transducers and signal conditioning techniques.

UNIT – I: Sensors Fundamentals and Characteristics 9

Principles, Parameters of Sensors, Types of mechanical and Electromechanical Sensors, Signals and Systems, Sensor Classification, Units of Measurements, Sensor Characteristics.

UNIT – II: Physical Principles of sensing 9

Electric Charges, Fields, and Potentials; Capacitance, Magnetism, Induction, Resistance, Piezoelectric Effect, Hall Effect, Temperature and Thermal Properties of Material, Heat Transfer, Light, Dynamic Models of Sensor Elements.

UNIT – III: Interface Electronic Circuits 9

Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors

UNIT – IV: Sensors in Different Application Area 9

Occupancy and Motion Detectors; Position, Displacement, and Level, Velocity and Acceleration, Force, Strain, and Tactile Sensors, Pressure Sensors, Temperature Sensors.

UNIT – V: Sensor Materials and Technologies 9

Materials, Surface Processing, Nano-Technology for Electrochemical Biosensor development, Carbon Nanotubes, Conductive polymer Nanostructures, Nano particles.

TOTAL PERIODS: 45

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OUTCOMES:

On Completion of the course the student should be able to:

- Apply the different techniques and determine the parameters of sensors.
- Understand the construction and working of various physical type of sensing and its applications.
- Analyze the applications of various interface electronics.
- Explore the different types of sensors and utilize it to design various applications.
- Describe the sensor materials and the technologies applied on it.

TEXT BOOKS:

1. Nathan Ida, "Sensors , Actuators and their Interfaces - A Multidisciplinary Approach",Scitech Publishing, 2014.
2. Songjun Li, Jagdish Singh, He Li, "Biosensor Nanomaterials", Wiley VCH, 2011.

REFERENCE BOOKS:

1. J. Fraden, "Handbook of Modern Sensors: Physical, Designs, and Applications", AIPPress, Springer, 2015.
2. D. Patranabis, "Sensors and Transducers", PHI Publication, 2nd Edition, 2015.
3. Patranabis,D., Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	-	-	-	-	2	2	2	-	-	-	-	2	2	-	-
2	3	-	-	1	-	1	2	2	-	-	-	-	3	3	-	-
3	3	2	2	2	-	2	3	3	-	-	-	-	3	3	-	-
4	2	2	3	3	-	3	3	3	-	-	-	-	3	3	-	-
5	3	-	-	2	-	3	3	3	-	-	-	-	3	2	-	-

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1906009 **MEDICAL ELECTRONICS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To acquire knowledge about the methods of recording various biopotentials.
- To gain knowledge about the various physiological parameters both electrical and non-electrical parameters.
- To study about the various assist devices used in the hospitals.
- To obtain knowledge about equipment used for physical medicine and the various recently developed diagnostic and therapeutic techniques.
- To learn about the recent trends in medical instrumentation.

UNIT - I: ELECTRO-PHYSIOLOGY AND BIO-POTENTIAL RECORDING 9

Sources of bio medical signals, Bio-potentials, Biopotential electrodes, biological amplifiers, ECG, EEG, EMG, PCG, typical waveforms and signal characteristics.

UNIT - II: BIO-CHEMICAL AND NON-ELECTRICAL PARAMETER MEASUREMENT 9

pH, PO2, PCO2, Colorimeter, Blood flow meter, Cardiac output, respiratory, blood pressure, temperature and pulse measurement, Blood Cell Counters.

UNIT - III: ASSIST DEVICES 9

Cardiac pacemakers, DC Defibrillator, Dialyser, Ventilators, Magnetic Resonance Imaging Systems, Ultrasonic Imaging Systems.

UNIT - IV: PHYSICAL MEDICINE AND BIOTELEMETRY 9

Diathermies- Shortwave, ultrasonic and microwave type and their applications, Surgical Diathermy, Biotelemetry.

UNIT - V: RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Telemedicine, Insulin Pumps, Radio pill, Endomicroscopy, Brain machine interface, Lab on a chip.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Know the human body electro- physiological parameters and recording of bio-potentials.

- Comprehend the non-electrical physiological parameters and their measurement – body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.
- Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators.
- Realize physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies, and bio-telemetry principles and methods.
- Analyze the recent trends in medical instrumentation.

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007.
2. Joseph J.Carr and John M.Brown, "Introduction to Biomedical Equipment Technology", John Wiley and Sons, New York, 2004.

REFERENCE BOOKS:

1. Khandpur, R.S.,"Handbook of Biomedical Instrumentation", TATA Mc Graw-Hill, New Delhi, 2003.
2. John Webster,"Medical Instrumentation Application and Design", 3rd Edition, Wiley India Edition, 2007.
3. Ed. Joseph D. Bronzino, "The Biomedical Engineering Hand Book", Third Edition, Boca Raton, CRC Press LLC, 2006.
4. M.Arumugam, "Bio-Medical Instrumentation", Anuradha Agencies, 2003.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	2	-	-	2		2	-	-	-	-	2	-	-	-
2	3	3	2	-	-		2	1	-	-	-	-	2	-	-	-
3	3	3	-	3	-	2		2	-	-	-	-	2	-	-	-
4	3	3	1	3	-	2	2	2	-	-	-	-	3	3	-	-
5	3	2	1	-	-	-	-	2	-	-	-	-	2	-	-	-

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1904511 **OPERATING SYSTEMS** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand Processes and Threads
- To analyze Scheduling algorithms.
- To understand the concept of Deadlocks.
- To analyze various memory management schemes.
- To understand I/O management and File systems.

UNIT I PROCESSES AND THREADS 9

Introduction to operating systems – Objectives and functions, Evolution of Operating System - operating system-structures – system calls – system programs –Processes: Process concept – Process scheduling – Operations on processes –Inter process communication.

UNIT II PROCESS SCHEDULING AND SYNCHRONIZATION 9

CPU Scheduling: Scheduling criteria – Scheduling algorithms – Process Synchronization: The critical-section problem –Synchronization hardware – Semaphores – Classical problems of synchronization –critical regions. Deadlock: System model – Deadlock characterization –Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance –Deadlock detection – Recovery from deadlock.

UNIT III STORAGE MANAGEMENT 9

Main Memory Management: Swapping – Contiguous memory allocation – Paging – Segmentation – Segmentation with paging. Virtual Memory: Demand paging – Process creation – Page replacement – Thrashing.

UNIT IV FILE SYSTEMS 9

File-System Interface: File concept – Access methods – Directory structure – File system mounting. File-System Implementation: Directory implementation – Allocation methods – Free-space management – recovery – log-structured file systems.

UNIT V I/O SYSTEMS 9

I/O Systems – I/O Hardware – Application I/O interface – kernel I/O subsystem - streams – performance. Mass-Storage Structure: Disk scheduling – Disk management – Swap-space management – disk attachment.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Analyze various scheduling algorithms.
- Understand deadlock, prevention and avoidance algorithms.
- Compare and contrast various memory management schemes.
- Understand the functionality of file systems.
- Understand the functionality I/O management

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”, 9th Edition, John Wiley and Sons Inc., 2012.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum, “Modern Operating Systems”, Second Edition, Pearson Education, 2004.
2. Gary Nutt, “Operating Systems”, Third Edition, Pearson Education, 2004.
3. Harvey M. Deitel, “Operating Systems”, Third Edition, Pearson Education, 2004.
4. Ramez Elmasri, A. Gil Carrick, David Levine, “Operating Systems – A Spiral Approach”, Tata McGraw Hill Edition, 2010.
5. Achyut S. Godbole, Atul Kahate, “Operating Systems”, McGraw Hill Education, 2016.
6. Daniel P Bovet and Marco Cesati, “Understanding the Linux kernel”, 3rd edition, O‘Reilly, 2005.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	-	1	-	-	-	-	-	-	2	-	-	-
CO 2	-	2	2	-	-	-	-	-	-	-	-	-	1	2	-	-
CO 3	-	-	-	2	2	-	-	-	-	-	-	-	-	1	-	-
CO 4	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-
CO 5	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	3

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1907002 ROBOTICS AND AUTOMATION L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge on the basic concepts associated with the design, functioning, applications and social aspects of robots
- To provide the concept of electrical drive systems and sensors used in robotics for various applications
- To make the students learn about analyzing robot kinematics, dynamics through different methodologies and study various design aspects of robot arm manipulator and end-effector
- To educate about various motion planning techniques and the associated control architecture
- To make the students explore the implications of AI and other trending concepts of robotics

UNIT - I FOUNDATION FOR BEGINNERS 9

Introduction -- brief history, definition, anatomy, types, classification, specification and need based applications; role and need of robots for the immediate problems of the society, future of mankind and automation-ethical issues; industrial scenario local and global, case studies on mobile robot research platform and industrial serial arm manipulator.

UNIT - II BUILDING BLOCKS OF A ROBOT 9

Types of electric motors – DC Servo, Stepper; specification, drives for motors - speed & direction control and circuitry, Selection criterion for actuators, direct drives, non-traditional actuators; Sensors for localization, navigation, obstacle avoidance and path planning in known and unknown environments – optical, inertial, thermal, chemical, biosensor, other common sensors; Case study on choice of sensors and actuators for maze solving robot and self driving cars.

UNIT - III KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS & END-EFFECTORS 9

Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator, WMR; End-effector - common types and design case study.

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UNIT - IV NAVIGATION, PATH PLANNING AND CONTROL ARCHITECTURE 9

Mapping & Navigation – SLAM, Path planning for serial manipulators; types of control architectures - Cartesian control, Force control and hybrid position/force control, Behaviour based control, application of Neural network, fuzzy logic, optimization algorithms for navigation problems, programming methodologies of a robot.

UNIT - V AI AND OTHER RESEARCH TRENDS IN ROBOTICS 9

Application of Machine learning - AI, Expert systems; Tele-robotics and Virtual Reality, Micro & Nano robots, Unmanned vehicles, Cognitive robotics, Evolutionary robotics, Humanoids.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the concepts of industrial robots in terms of classification, specifications and coordinate systems, along with the need and application of robots & automation
- Examine different sensors and actuators for applications like maze solving and self-driving cars.
- Design a 2R robot & an end-effector and solve the kinematics and dynamics of motion for robots.
- Explain navigation and path planning techniques along with the control architectures adopted for robot motion planning.
- Describe the impact and progress in AI and other research trends in the field of robotics

TEXT BOOKS:

1. Saeed. B. Niku, “Introduction to Robotics, Analysis, system, Applications”, Pearson educations, 2002.
2. Roland Siegwart, Illah Reza Nourbakhsh, “Introduction to Autonomous Mobile Robots”, MIT Press, 2011.

REFERENCE BOOKS:

1. Richard David Klafter, Thomas A. Chmielewski, Michael Negin, “Robotic engineering: an integrated approach”, Prentice Hall, 1989
2. Craig, J. J., “Introduction to Robotics: Mechanics and Control”, Second Edition, Addison-Wesley, 1989.

3. K.S. Fu, R.C. Gonzalez and C.S.G. Lee, “Robotics: Control, Sensing, Vision and Intelligence”, McGraw-Hill, 1987.
4. Wesley E Snyder R, “Industrial Robots, Computer Interfacing and Control”, Prentice Hall International Edition, 1988.
5. Robin Murphy, “Introduction to AI Robotics”, MIT Press, 2000
6. Ronald C. Arkin, “Behaviour-based Robotics”, MIT Press, 1998
7. N. P. Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press, 2005
8. Stefano Nolfi, Dario Floreano, “Evolutionary Robotics – The Biology, Intelligence and Technology of Self–Organizing Machines” (Intelligent Robotics and Autonomous Agents series), MIT Press, 2004

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO 1	1	1	1	1	1	-	-	1	-	-	-	-
CO 2	1	1	1	1	1	-	-	1	-	-	-	-
CO 3	3	3	3	3	3	-	-	3	-	-	-	-
CO 4	3	3	3	3	3	-	-	3	-	-	-	-
CO 5	3	3	3	3	3	-	-	3	-	-	-	-

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1921503 **NANOTECHNOLOGY AND APPLICATIONS** **L T P C**

3 0 0 3

OBJECTIVES

- To provide a broad view of the nascent field of nanoscience and nanotechnology to undergraduates
- To explore the basics of nanomaterial synthesis and characterization.
- To introduce the applications of nanotechnology
- To make the student conversant with the latest characterization techniques
- To provide instances of contemporary industrial applications of nanotechnology

UNIT-I: INTRODUCTION TO NANOTECHNOLOGY 9

Basic Structure of Nanoparticles- Kinetics in Nanostructured Materials- Zero dimensional, size and shape of nanoparticles; one-dimensional and two dimensional nanostructures- Clusters of metals and semiconductors, bio nano-particles.

UNIT-II: FABRICATION AND CHARACTERIZATION OF NANOMATERIALS 9

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Gas, liquid, and solid –phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition; Electrospinning. Bio-synthesis of nanomaterials.

UNIT-III: PROPERTIES AND MEASUREMENT OF NANOMATERIALS 9

Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

UNIT-IV: NANO STRUCTURES 9

Carbon Nanotubes, Fullerenes, Nanowires, Quantum dots, Applications of nanostructures. Reinforcement in Ceramics, Drug delivery, Giant magneto resistance, Cells response to Nanostructures.

UNIT-V: APPLICATIONS OF NANOTECHNOLOGY 9

Nanoelectronics, Nano sensors, Nanotechnology in Diagnostics applications, Environmental applications of nanotechnology, Nano technology for energy systems.

Total Periods: 45

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OUTCOMES

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

1. Describe the basic science behind the properties of materials.
2. Interpret the creation, characterization, and manipulation of nanoscale materials.
3. Comprehend the exciting applications of nanotechnology at the leading edge of scientific research.
4. Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.
5. Outline the application of nanomaterials for various fields.

TEXT BOOKS:

1. Bharat Bhushan, Handbook of Nanotechnology, Springer, 2004.
2. Hari Singh Nalwa, Encyclopedia of Nanoscience and Nanotechnology, American Scientific Publishers, 2004.

REFERENCE BOOKS:

1. D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Nanomaterials, Nanotechnologies and Design: An Introduction to Engineers and Architects, Butterworth-Heinemann, 2009.
2. Z.L. Wang, Y. Liu, Z. Zhang, Handbook of Nanophase and Nanostructured Materials, Springer, 2003.
3. Tseung-Yuen Tseng and Hari Singh Nalwa, Handbook of Nanoceramics and their Based Nanodevices (Vol. 2), American Scientific Publishers, 2009.
4. Korada, Viswanatha Sharma, Hamid, Nor Hisham, Engineering Applications of Nanotechnology: From Energy to Drug Delivery, Springer, 2017.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	1	-	-	-	1	1	-	-	-	-	-	1	-	-	1	-
CO 2	2	1	1	1	1	1	-	-	-	-	-	1	2	-	1	-
CO 3	2	1	2	1	1	1	-	-	-	-	-	1	1	-	1	-
CO 4	1	1	1	1	1	1	-	-	-	-	-	1	1	-	1	-
CO 5	1	2	1	2	1	-	-	-	-	-	-	1	2	1	1	-

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SEMESTER VI

PROFESSIONAL ELECTIVE-II

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1906603	Cryptography and Network Security	PE	3	3	0	0	3
2.	1906007	Advanced Digital Signal Processing	PE	3	3	0	0	3
3.	1908609	Internet of Things & Its Applications	PE	3	3	0	0	3
4.	1906604	Multimedia Compression and Communication	PE	3	3	0	0	3
5.	1915002	Principles of Management	PE	3	3	0	0	3

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1906603 CRYPTOGRAPHY AND NETWORK SECURITY L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand OSI security architecture and classical encryption techniques.
- To explore Cryptography Theories, Algorithms and Systems.
- To acquire fundamental knowledge on the concepts of finite fields and number theory.
- To describe the principles of public key cryptosystems, hash functions and digital signature.
- To comprehend the Approaches and Techniques to build protection mechanisms in order to secure computer networks.

UNIT – I: INTRODUCTION 9

Security trends - Legal, Ethical and Professional Aspects of Security, Need for Security at Multiple levels, Security Policies - Model of network security – Security attacks, services and mechanisms – OSI security architecture – Classical encryption techniques: substitution techniques, transposition techniques, steganography).- Foundations of modern cryptography: perfect security – information theory – product cryptosystem – cryptanalysis.

UNIT – II: SYMMETRIC CRYPTOGRAPHY 9

Mathematics Of Symmetric Key Cryptography: Algebraic structures - Modular arithmetic-Euclid‘s algorithm- Congruence and matrices - Groups, Rings, Fields- Finite fields-Symmetric Key Ciphers: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Advanced Encryption Standard - RC4 – Key distribution.

UNIT – III: PUBLIC KEY CRYPTOGRAPHY 9

Mathematics Of Asymmetric Key Cryptography: Primes – Primality Testing – Factorization – Euler‘s totient function, Fermat‘s and Euler‘s Theorem - Chinese Remainder Theorem – Exponentiation and logarithm - ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.

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UNIT – IV: MESSAGE AUTHENTICATION AND INTEGRITY 9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS-Entity Authentication: Biometrics, Passwords, Challenge Response protocols-Authentication applications - Kerberos, X.509.

UNIT – V: SECURITY PRACTICE AND SYSTEM SECURITY 9

Electronic Mail security – PGP, S/MIME – IP security – Web Security - SYSTEM SECURITY: Intruders – Malicious software – viruses – Firewalls.

TOTAL PERIODS: 45

OUTCOMES:

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

- Explain the fundamentals of networks security, security architecture, threats and vulnerabilities.
- Apply the different cryptographic operations of symmetric and public key cryptographic algorithms.
- Interpret the secure coding in the developed applications.
- Analyze the various Authentication schemes to simulate different applications.
- Describe various Security practices and System security standards.

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security", 6th Edition, Pearson Education, March 2013.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security", Prentice Hall of India, 2002.

REFERENCE BOOKS:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill, 2007.
2. Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols", Wiley Publications, 2003.
3. Charles Pfleeger, "Security in Computing", 4th Edition, Prentice Hall of India, 2006.
4. Ulysess Black, "Internet Security Protocols", Pearson Education Asia, 2000.
5. Charlie Kaufman and Radia Perlman, Mike Speciner, "Network Security, Second Edition, Private Communication in Public World", PHI 2002.

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COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	3	-	-	-	-	-	-	-	2	2	2	-	-
2	2	3	2	2	-	-	2	2	-	-	-	2	2	2	-	-
3	2	2	2	3	-	-	-	-	-	-	-	2	2	2	-	-
4	3	2	2	2	-	2	-	2	-	-	-	2	2	2	-	-
5	3	3	2	3	-	2	-	2	-	-	-	2	2	2	-	-

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1906007 ADVANCED DIGITAL SIGNAL PROCESSING L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

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

UNIT – I: DISCRETE-TIME RANDOM PROCESSES 9

Random variables - Ensemble averages a review, Random processes - Ensemble averages, Autocorrelation and autocovariance matrices, Ergodic random process, White noise, Power spectrum, Filtering random processes, spectral factorization, Special types of random processes - AR, MA, ARMA.

UNIT – II: SPECTRUM ESTIMATION 9

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

UNIT – III: OPTIMUM FILTERS 9

Wiener filters - FIR Wiener filter - Discrete Wiener Hopf equation, Applications - filtering, Linear prediction, Noise cancellation. IIR Wiener filter - Causal and non-causal filters. Recursive estimators - Discrete Kalman filter.

UNIT – IV: ADAPTIVE FILTERS 9

Principles and properties of adaptive filters - FIR adaptive filters. Adaptive algorithms - Steepest descent algorithm, The LMS algorithm – Convergence. Applications of adaptive filtering - Noise cancellation, Channel equalization.

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UNIT – V: **MULTIRESOLUTION ANALYSIS** **9**

Short-time Fourier transform - Heisenberg uncertainty principle- Principles of multi-resolution analysis – Speech Signal-Sub-band coding, Continuous and discrete wavelet transform - Properties. Applications of wavelet transform - Noise reduction, Image compression.

TOTAL PERIODS: 45

OUTCOMES:

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

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

TEXT BOOKS:

1. Monson H. Hayes, "Statistical digital signal processing and modeling", John Wiley and Sons Inc. New York, Indian reprint 2008.
2. P. P. Vaidyanathan, "Multirate systems and filter banks", Prentice Hall Inc. 1993.

REFERENCE BOOKS:

1. John G. Proakis & Dimitris G.Manolakis, “Digital Signal Processing-Principles, Algorithms & Applications”, Fourth Edition, Pearson Education / Prentice Hall, 2007.
2. Sophoncles J. Orfanidis, "Optimum signal processing", McGraw Hill, 2000.
3. Simon Haykin, “Adaptive Filter Theory”, Prentice Hall, Englehood Cliffs, NJ1986.
4. Sanjit K. Mitra, “Digital Signal Processing - A Computer Based Approach”, Tata Mc Graw Hill, 2007.
5. Andreas Antoniou, “Digital Signal Processing”, Tata Mc Graw Hill, 2006.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	1	2	-	1	-	-	1	-	-	3	3	1	3	-
2	3	3	2	2	-	1	-	-	1	-	-	3	3	1	3	-
3	3	3	2	2	-	1	-	-	1	-	-	2	3	1	3	-
4	3	3	2	1	-	3	-	-	1	-	-	1	3	2	3	-
5	3	3	3	3	-	3	-	-	1	-	-	2	3	2	3	-

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1908609 INTERNET OF THINGS AND ITS APPLICATIONS L T P C

3 0 0 3

OBJECTIVES:

1. Understand Smart Objects and IoT Architectures.
2. Learn about various IOT-related protocols.
3. Build simple IoT Systems using Arduino and Raspberry Pi.
4. Understand data analytics and cloud in the context of IoT.
5. Develop IoT infrastructure for popular applications.

UNIT - I: FUNDAMENTALS OF IoT 9

Evolution of Internet of Things - Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem – Sensors, Actuators, Smart Objects and Connecting Smart Objects

UNIT - II: IoT PROTOCOLS 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Transport Methods: Supervisory Control and Data Acquisition – Application Layer Protocols: CoAP and MQTT

UNIT - III: DESIGN AND DEVELOPMENT 9

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT - IV: DATA ANALYTICS AND SUPPORTING SERVICES 9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest – Role of Machine Learning – No SQL Databases – Hadoop Ecosystem – Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics – Xively Cloud for IoT, Python Web Application Framework – Django – AWS for IoT – System Management with NETCONF-YANG

UNIT - V: CASE STUDIES 9

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plant wide Ethernet Model (CPwE) – Power Utility Industry – Grid Blocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

TOTAL: 45 PERIODS

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OUTCOMES:

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

- Understand all basic foundation of IoT
- Explain the functional block of IoT.
- Analyze various protocols for IoT.
- Design a PoC of an IoT system using Rasperry Pi/Arduino
- Apply data analytics and use cloud offerings related to IoT.

TEXT BOOKS:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, —IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things – Key applications and Protocols, Wiley, 2012 .

REFERENCE BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things – A hands-on approach, Universities Press, 2015
2. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), —Architecting the Internet of Things, Springer, 2011.
4. Michael Margolis, Arduino Cookbook, Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, O'Reilly Media, 2011.6. https://www.arduino.cc/

CO - PO and CO - PSO MAPPING:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 4	-	-	-	3	-	3	3	-	-	-	-	-	-	-	2	-
CO 5	-	-	-	3	-	3	3	-	-	-	-	-	-	-	2	-

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1906604 MULTIMEDIA COMPRESSION AND COMMUNICATION **L T P C**
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the concept of error–control coding.
- Examine encoding and decoding of digital data streams.
- Analyze the generation of compression codes and their decoding techniques.
- Have a detailed knowledge of compression and decompression techniques.
- Apply the concepts of compression techniques in multimedia communication.

UNIT - I: MULTIMEDIA COMPONENTS 9

Introduction - Multimedia skills - Multimedia components and their characteristics - Text, sound, images, graphics, animation, video, hardware

UNIT - II: AUDIO AND VIDEO COMPRESSION 9

Audio compression–DPCM-Adaptive PCM –adaptive predictive coding-linear Predictive coding-code excited LPC-perpetual coding Video compression –principles-H.261-H.263-MPEG 1, 2, and 4.

UNIT - III: TEXT AND IMAGE COMPRESSION 9

Compression principles-source encoders and destination encoders-lossless and lossy compression- entropy encoding –source encoding -text compression –static Huffman coding dynamic coding – arithmetic coding –Lempel ziv-welsh Compression-image compression

UNIT - IV: VOIP TECHNOLOGY 9

Basics of IP transport, VoIP challenges, H.323/ SIP –Network Architecture, Protocols, Call establishment and release, VoIP and SS7, Quality of Service- CODEC Methods- VOIP applicability

UNIT - V: MULTIMEDIA NETWORKING 9

Multimedia networking -Applications-streamed stored and audio-making the best Effort service- protocols for real time interactive Applications-distributing multimedia-beyond best effort service- secluding and policing Mechanisms-integrated services-differentiated Services-RSVP

TOTAL PERIODS: 45

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OUTCOMES:

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

- Describe various multimedia components
- Analyse compression and decompression techniques
- Apply the compression concepts in multimedia communication
- Design a system with VOIP Technology
- Explore the applications of Multimedia Networking protocols.

TEXT BOOKS:

1. Fred Halshall "Multimedia communication - Applications, Networks, Protocols and Standards", Pearson Education, 2007.
2. Tay Vaughan, "Multimedia: Making it work", 7 th Edition, TMH 2008

REFERENCE BOOKS:

1. Kurose and W.Ross "Computer Networking "a Top Down Approach", Pearson Education 2005
2. KR. Rao,Z S Bojkovic, D A Milovanovic, "Multimedia Communication Systems: Techniques, Standards, and Networks", Pearson Education 2007
3. H P Hsu, Schaum Outline Series - "Analog and Digital Communications", TMH 2006
4. R. Steimnetz, K. Nahrstedt, "Multimedia Computing, Communications and Applications", Pearson Education Ranjan Parekh, "Principles of Multimedia", TMH 2007

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	2	-	-	-	-	-	-	-	3	2	2	-	-
2	3	2	2	1	-	-	-	-	-	-	-	3	3	2	-	-
3	3	2	2	1	-	-	-	-	-	-	-	3	2	2	-	-
4	3	3	3	3	-	-	-	-	-	-	-	3	3	3	-	-
5	3	2	2	1	-	-	2	2	-	-	-	3	2	2	-	-

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1915002 **PRINCIPLES OF MANAGEMENT** **LT P C**

3 0 0 3

OBJECTIVES:

- To study the principles of management, functions and its application an organization.
- To educate the students on the concept of planning and decision making.
- To understand the dynamics of human relations in organisations.
- To learn about motivation, communication and leadership aspects.
- To study the process controlling and the various techniques involved in controlling.

UNIT – I: INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS **9**

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers managerial roles and skills –Evolution of Management – Scientific, human relations, system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment –Multinational Corporations - Current trends and issues in Management.

UNIT – II: PLANNING **9**

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management –types of strategies – Planning Tools and Techniques – Decision making steps and process.

UNIT – III: ORGANISING **9**

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Talent Acquisition, Training and Development, Performance Management, Career planning and management.

UNIT – IV: DIRECTING **9**

Motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication

– communication and IT.

UNIT – V: CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Quality control and Inventory Control - Productivity problems and management – control and performance – direct and preventive control – Maintenance control and purchase control– reporting.

TOTAL: 45 PERIODS

OUTCOMES:

- Students will be able to have a clear understanding of managerial functions.
- Students would have knowledge to apply planning techniques and decision making.
- Understand concept of Human Resource Management.
- Students would be able to understand motivation, leadership and communication principles.
- Students would be able to apply control techniques in the organization.

TEXTBOOKS:

1. Stephen P. Robbins & Mary Coulter, “Management”, 14th Edition, Pearson, 2017
2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson, 2004.

REFERENCE BOOKS:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” 10th Edition, Pearson Education, 2016.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of management” Tata Mc Graw Hill, 2006.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 6th edition 2017.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	1	-	-	-	-	-	-	1	-	2	-	-	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	1
CO5	-	-	1	-	1	-	1	-	-	-	1	-	-	-	1	-

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SEMESTER VI

PROFESSIONAL ELECTIVE-III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1904609	Soft Computing	PE	3	3	0	0	3
2.	1904006	Artificial Intelligence	PE	3	3	0	0	3
3.	1904012	Machine Learning	PE	3	3	0	0	3
4.	1904011	Big Data Analytics	PE	3	3	0	0	3
5.	1920001	Fundamentals of Nanoscience	PE	3	3	0	0	3

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1904609 **SOFT COMPUTING** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the various soft computing frame works
- Be familiar with design of various neural networks.
- To understand the concepts of fuzzy logic.
- To have an idea about genetic programming.
- To understand about Hybrid systems.

UNIT I **INTRODUCTION** **9**

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models – important technologies – applications. Fuzzy logic: Introduction – crisp sets- fuzzy sets – crisp relations and fuzzy relations: cartesian product of relation – classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction – biological background – traditional optimization and search techniques – Genetic basic concepts.

UNIT II **NEURAL NETWORKS** **9**

McCulloch-Pitts neuron – linear separability – hebb network – supervised learning network: perceptron networks – adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto-associative memory network, hetero-associative memory network, BAM, hopfield networks, iterative auto associative memory network & iterative associative memory network –unsupervised learning networks: Kohonen self organizing feature maps, LVQ – CP networks, ART network.

UNIT III **FUZZY LOGIC** **9**

Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts – methods – fuzzy arithmetic and fuzzy measures: fuzzy arithmetic – extension principle – fuzzy measures – measures of fuzziness -fuzzy integrals – fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules- decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems- overview of fuzzy expert system-fuzzy decision making.

UN IT IV **GENETIC ALGORITHM** **9**

History of Genetic Algorithms (GA), Working Principle, Various Encoding methods, Fitness function, GA Operators-Reproduction, Crossover, Mutation, Convergence of GA, Bit wise operation in GA,

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Multi-level Optimization.

UNIT V HYBRID SYSTEMS 9

Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the student should be able to:

- To Apply various soft computing frame works.
- To Design of various neural networks.
- To understand the concepts of fuzzy logic.
- To Apply genetic programming.
- To Discuss hybrid soft computing.

TEXT BOOKS:

1. J.S.R.Jang, C.T. Sun and E.Mizutani, “Neuro-Fuzzy and Soft Computing”, PHI / Pearson Education 2004.
2. S.N.Sivanandam and S.N.Deepa, “Principles of Soft Computing”, Wiley India Pvt Ltd, 2011

REFERENCE BOOKS:

1. S.Rajasekaran and G.A.Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis & Applications”, Prentice-Hall of India Pvt. Ltd., 2006.
2. George J. Klir, Ute St. Clair, Bo Yuan, “Fuzzy Set Theory: Foundations and Applications” Prentice Hall, 1997.
3. David E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning” Pearson Education India, 2013.
4. James A. Freeman, David M. Skapura, “Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India, 1991.
5. Simon Haykin, “Neural Networks Comprehensive Foundation” Second Edition, Pearson Education, 2005.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-
CO 2	-	-	2	-	-	2	2	-	-	-	-	-	-	1	-	-
CO 3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-
CO 4	-	-		2	-	1	-	-	-	-	-	-	-	-	-	2
CO 5	-	-		2	-	-	-	-	-	-	-	-	-	-	-	-

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1904006 **ARTIFICIAL INTELLIGENCE** **L T P C**
3 0 0 3

COURSE OBJECTIVES :

The student should be made to:

- To understand the various characteristics of Intelligent agents
- To learn the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To know about the various applications of AI.

UNIT - I: INTRODUCTION 9

Introduction - Foundation and history of AI. AI Problems and techniques - AI programming languages – Introduction to LISP and PROLOG – Problem spaces and searches -Blind search strategies; Breadth first - Depth first –Heuristic search techniques Hill climbing - Best first – A* algorithm AO* algorithm – game trees Minimax algorithm – Game playing – Alpha beta pruning.

UNIT : II: KNOWLEDGE REPRESENTATION 9

Knowledge representation issues – Predicate logic – logic programming – Sematic nets - Frames and inheritance - constraint propagation –Representing Knowledge using rules – Rules based deduction system.

UNIT - III: REASONING UNDER UNCERTAINTY 9

Introduction to uncertain knowledge review of probability – Baye's Probabilistic inferences and Dempster Shafer theory –Heuristic methods – Symbolic reasoning under uncertainty- Statistical reasoning – Fuzzy reasoning – Temporal reasoning- Non monotonic reasoning.

UNIT - IV: PLANNING AND LEARNING 9

Planning - Introduction, Planning in situational calculus - Representation for planning – Partial order planning algorithm- Learning from examples- Discovery as learning – Learning by analogy – Explanation based learning –Introduction to Neural nets – Genetic Algorithms.

UNIT - V: APPLICATIONS 9

Principles of Natural Language Processing Rule Based Systems Architecture - Expert systems- Knowledge Acquisition concepts – AI application to robotics – Current trends in Intelligent Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

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

- Use appropriate search algorithms for any AI problem
- Represent a problem using first order and predicate logic
- Provide the apt agent strategy to solve a given problem
- Design software agents to solve a problem
- Design applications for NLP that use Artificial Intelligence

TEXT BOOKS:

1. Patrick Henry Winston,” Artificial Intelligence”, Addison Wesley, Books Third edition, 2000.

REFERENCE BOOKS:

1. George F Luger, Artificial Intelligence, Pearson Education, 6th edition,2009.
2. Engene Charniak and Drew Mc Dermott,” Introduction to Artificial intelligence, Addison Wesley 2000.
3. Nils J. Nilsson,”Principles of Artificial Intelligence“, Narosa Publishing House, 2000

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												Program Specific Outcomes(PSO)			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO 1	-	1	-	-	-	3	-	-	-	-	-	-	2	-	-	-
CO 2	-	-	2	-	-	-	-	-	-	-	-	-		3	-	-
CO 3	3	-	-	2	-	-	-	-	-	-	-	-	1	-	-	-
CO 4	-	2	-	-	3	-	-	-	-	-	-	-	-	2	-	-
CO 5	2	-	2	-	-	-	-	-	-	-	-	-	3	-	-	2

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1904012	MACHINE LEARNING	L T P C
		3 0 0 3

Objectives:

- To introduce various types of machine learning and its basics functions.
- To provide an insight to different supervised learning techniques, merits and demerits.
- To enable the students to understand Graphical models and their applicability to real world problems.
- To study the various probability based learning techniques.
- To study and evaluate dimensionality reduction for the given data.

UNIT–I INTRODUCTION 9

Machine learning: What and why? - Examples of Machine Learning Applications - Types Of Machine Learning Supervised Learning - Machine Learning Process- The Curse of Dimensionality, Overfitting - Training, Testing, and Validation Sets-The Confusion Matrix & Basic Statistics-Bias-Variance Tradeoff

UNIT-II NEURONS, NEURAL NETWORKS, AND LINEAR DISCRIMINANTS 9

Hebb's Rule - Neural Networks - The Perceptron - LinearSeparability& Linear Regression. The Multi-layer Perceptron: Biases, Algorithm - Local minima and Stochastic gradient Descent Examples Of Using The MLP : Regression Problem & Classification Example - Deriving Back-Propagation

UNIT – III DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS 9

Linear Discriminant Analysis (LDA) - PRINCIPAL COMPONENTS ANALYSIS (PCA), Factor Analysis - Independent Components Analysis - **PROBABILISTIC MODEL -** Gaussian Mixture Models : EM Algorithm - Nearest Neighbour Methods - Support Vector Machines

UNIT IV – LEARNING 9

Evolutionary Learning **-** The Genetic Algorithms (GA)-Reinforcement Learning -Decision Trees - CLASSIFICATION AND REGRESSION TREES (CART) - Ensemble Learning : Boosting, Bagging, Random Forests - Unsupervised Learning : K-Means – Algorithm - Vector Quantization

UNIT- V GRAPHICAL MODELS 9

Bayesian Networks - Markov Random Fields - Hidden Markov Models (HMMS) - Markov Chain Monte Carlo (MCMC) Methods - Deep Belief Networks (DBN)

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OUTCOMES:

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

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the appropriate machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency

TEXT BOOK:

1. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

REFERENCE BOOKS:

1. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014.

2. Tom M. Mitchell, ―Machine Learning‖, McGraw-Hill Education (India) Private Limited, 2017.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	-	-	2	-	-	-	-	-	-	-	3	-	-	-
CO3	3	-	-	3	-	2	-	-	-	-	-	-	-	2	-	-
CO4	3	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	2	2	2	-	-	-	-	-	-	-	-	-	-	3	2

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1904011 BIG DATA ANALYTICS

L T P C

3 0 0 3

OBJECTIVES:

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

UNIT I INTRODUCTION TO BIG DATA 9

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

UNIT II HADOOP FRAMEWORK 9

Distributed File Systems - Large-Scale File System Organization – HDFS concepts - MapReduce Execution, Algorithms using Map Reduce, Matrix-Vector Multiplication – Hadoop YARN.

UNIT III DATA ANALYSIS 9

Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data.

UN IT IV MINING DATA STREAMS 9

Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

UNIT V BIG DATA FRAMEWORKS 9

Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand how to leverage the insights from big data analytics.
- Analyze data by utilizing various statistical and data mining approaches.
- Perform analytics on real-time streaming data.
- Understand the various NoSql alternative database models.
- To implement Big Data Framework in Hbase.

TEXT BOOKS:

1. Bill Franks, —Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012
2. Chris Eaton, Dirk deroos et al. , "Understanding Big data ", McGraw Hill, 2012.
3. Vignesh Prajapati,"Big Data Analytics with R and Hadoop", Packt Publishing Ltd., 2013.

REFERENCE BOOKS:

1. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
2. Michael Berthold, David J. Hand, —Intelligent Data Analysis‖, Springer, Second Edition, 2007.
3. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
4. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
5. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, , O'Reilly Media, 2013.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-		3	-	-	-	2	-	-	-	-	-	2
CO2	-	-	-	-	3	3	-	-	-	3	-	-	-	3	-	-
CO3	-	3	2	-	-	3	-	-	2	2	-	-	-	-	3	-
CO4	3	2	-	-	-	3	-	-	-	2	-	-	-	2	-	-
CO5	2	-	-	-	3	3	-	-	-	2	-	-	-	-	3	2

1920001 FUNDAMENTALS OF NANOSCIENCE

L	T	P	C
3	0	0	3

OBJECTIVE:

- To learn about basis of nanomaterials and their properties.
- To learn the general preparation techniques of nanomaterials.
- To make the students learn the different synthesis techniques of nanomaterials.
- To explore various characterization techniques.
- To elucidate the different applications of nanomaterials.

UNIT-I: INTRODUCTION 9

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

UNIT- II: GENERAL METHODSOF PREPARATION 9

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

UNIT- III: NANOMATERIALS 9

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationships applications- Nanometal oxides- ZnO,TiO2,MgO, ZrO2, NiO, nano alumina, Ferrites, Quantum wires, Quantum dots-preparation, properties and applications.

UNIT- IV: CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA,SIMS-Nano indentation.

UNIT-V: APPLICATION 9

Nano InfoTech: Information storage- nano computer, molecular switch, super chip, nano crystal, Nano biotechnology: nano probes in medical diagnostics and biotechnology, Nano medicines, Targeted drug delivery, Bio imaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nano sensors, nano crystalline silver for bacterial inhibition, Nano particles for sun barrier products - In Photostat, printing, solar cell, battery.

TOTAL : 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials.
- Will demonstrate the preparation of nanomaterials.
- Will get knowledge on different materials and their synthesize technique.
- Will develop knowledge in characteristic nanomaterials.
- Will learn where and how to apply the various properties of nanomaterials.

TEXT BOOKS:

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia,1996.
2. N John Dinardo, “Nanoscale Characterization of surfaces & Interfaces”, 2nd edition, Weinheim Cambridge, Wiley-VCH,2000.

REFERENCE BOOKS:

1. G Timp, “Nanotechnology”, AIP press/Springer,1999.
2. AkhleshLakhtakia, “The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations”. Prentice-Hall of India (P) Ltd, New Delhi, 2007.
3. Mark Ratner and Daniel Ratner, “Nano Technology”, Pearson Education, New Delhi, 2003.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	3	3	3	1	-	-	-	-	-	1	2	-	-	
CO2	2	-	3	3	3	-	-	-	-	-	-	1	2	-	-	-
CO3	2	-	3	3	3	-	-	-	-	-	-	1	2	-	-	-
CO4	2	-	3	3	3	1	1	-	-	-	-	1	2	-	-	-
CO5	3	-	3	3	3	1	1	-	-	-	-	1	2	1	-	-

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SEMESTER VIII

PROFESSIONAL ELECTIVE-IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1906801	Radar and Navigational Aids	PE	3	3	0	0	3
2.	1906802	RF System Design	PE	3	3	0	0	3
3.	1906803	Cognitive Radio	PE	3	3	0	0	3
4.	1906804	Mixed Signal IC Design	PE	3	3	0	0	3
5.	1906004	Electronics Packaging and Testing	PE	3	3	0	0	3

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1906801 RADAR AND NAVIGATIONAL AIDS **L T P C**
3 0 0 3

OBJECTIVES: The student should be made:

- To apply Doppler principle to radars and hence detect moving targets, cluster, also to understand tracking radars.
- To refresh principles of antennas and propagation as related to radars, also study of transmitters and receivers.
- To understand principles of navigation, in addition to approach and landing aids as related to navigation.
- To study about Error in direction finding and Range and Accuracy of Direction Finders.
- To become familiar with distance measuring equipments and satellite navigation systems.

UNIT – I: INTRODUCTION TO RADAR EQUATION 9

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

UNIT – II: MTI AND PULSE DOPPLER RADAR 9

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

UNIT – III: DETECTION OF SIGNALS IN NOISE 9

Matched –Filter Receiver –Detection Criteria – Detectors –-Automatic Detector - Integrators - Constant-False-Alarm Rate Receivers - The Radar operator - Signal Management - Propagation Radar Waves - Atmospheric Refraction -Standard propagation - Nonstandard

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Propagation - The Radar Antenna - Reflector Antennas - Electronically Steered Phased Array Antennas – Phase Shifters - Frequency-Scan Arrays Radar Transmitters and Receivers - Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron - Crossed Field Amplifiers - Other RF Power Sources – Other aspects of Radar Transmitter.- The Radar Receiver - Receiver noise Figure – Super heterodyne Receiver - Duplexers and Receiver Protectors- Radar Displays.

UNIT – IV: RADIO DIRECTION AND RANGES 9

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

UNIT – V: SATELLITE NAVIGATION SYSTEM 9

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

TOTAL PERIODS: 45

OUTCOMES:

After studying this course, the student should be able to,

- Explain the principles of navigation, in addition to approach and landing aids as related to navigation.
- Derive and discuss the Range equation and the nature of detection.
- Describe about the navigation systems using the satellite.
- Analyze the Automatic Direction Finders and Errors in Direction Finding.
- Understand the operation of navigation system and its measuring instruments.

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TEXT BOOKS:

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

REFERENCE BOOKS:

1. Peyton Z. Peebles, "Radar Principles", John Wiley, 2004.
2. J.C Toomay, “Principles of Radar", 2nd Edition, PHI, 2004.
3. Mark A. Richards “Fundamentals of Radar Signal Processing”, 2nd McGraw-Hill 2005.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	-	3	-	-	-	-	-	-	2	3	-	-	-
CO2	3	3	-	2	3	-	-	-	-	-	-	2	3	-	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	1	3	2	-	-
CO4	3	3	2	3	3	-	-	-	-	-	-	1	3	2	-	-
CO5	3	3	2	-	3	-	-	-	-	-	-	2	3	3	-	-

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1906802 **RF SYSTEM DESIGN** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- Familiarize with RF transceiver system design for wireless communications.
- To understand the importance and issues in the design of RF.
- To study about the Feedback systems and to design the amplifiers.
- Be exposed to design methods of PLL and frequency Synthesizer.
- To analyse the characteristics of oscillators, mixers, PLL, wireless synthesizers and detector.

UNIT – I: CMOS PHYSICS, TRANSCEIVER SPECIFICATIONS AND ARCHITECTURES 9

Introduction to MOSFET Physics, Noise: Thermal, shot, Flicker, Popcorn noise, Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link, Homodyne Receiver, Heterodyne Receiver, Image reject, Low IF Receiver Architectures Direct up conversion Transmitter, Two step up conversion Transmitter.

UNIT – II: IMPEDANCE MATCHING AND AMPLIFIERS 9

S-parameters with Smith chart, Passive IC components, Impedance matching networks, Common Gate, Common Source Amplifiers, OC Time constants in bandwidth estimation and enhancement, High Frequency amplifier design, Power match and Noise match, Single ended and Differential LNAs, Terminated with Resistors and Source Degeneration LNAs.

UNIT – III: FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

Stability of feedback systems: Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations , Compensation, General model – Class A, AB, B, C, D, E and F amplifiers, Power amplifier Linearization Techniques, Efficiency boosting techniques, ACPR metric, Design considerations.

UNIT – IV: PLL AND FREQUENCY SYNTHESIZERS 9

Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps, Integer-N frequency synthesizers, Direct Digital Frequency Synthesizers.

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UNIT – V: MIXERS AND OSCILLATORS **9**

Mixer characteristics, Non-linear based mixers, Quadratic mixers, Multiplier based mixers, Single balanced and double balanced mixers, Sub sampling mixers, Oscillators describing Functions, Colpitts oscillators, Resonators, Tuned Oscillators, Negative resistance oscillators, Phase noise.

TOTAL PERIODS: 45

OUTCOMES:

On completion of the course, the student should be able to,

- Describe the operation of RF transceiver systems.
- Apply knowledge to identify a suitable architecture and systematically design an RF system.
- Explain the concept of feedback systems and able to design power amplifiers.
- Analyse the filters and frequency synthesizer.
- Interpret the design methods of mixers and oscillators.

TEXT BOOKS:

1. Thomas Lee," The Design of Radio Frequency CMOS Integrated Circuits", Cambridge University Press, 2nd Edition, Cambridge, 2004.
2. Matthew M.Radmanesh," Radio frequency and Microwave Electronics illustrated", Pearson Education Inc, Delhi, 2006.

REFERENCE BOOKS:

1. B.Razavi, "RF Microelectronics", Pearson Education, 1997.
2. Devendra.K. Misra," Radio Frequency and Microwave communication Circuits– Analysis and Design", John Wiley and Sons, New York, 2004.
3. B. Razavi, "Design of Analog COMS Integrated Circuits", Mc Graw Hill, 2001.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	2	-	-	-	-	-	-	-	2	3	2	-	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3	2	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	2	3	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	3	2	-	-
CO5	3	3	3	2	-	-	-	-	-	-	-	2	3	2	-	-

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1906803 **COGNITIVE RADIO** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To study the evolving software defined radio and cognitive radio techniques and their essential functionalities.
- To learn the basic architecture and standard for cognitive radio.
- To understand the physical, MAC and Network layer design and protocols of cognitive radio.
- To enhance the student knowledge in the requirements of next generation wireless networks.
- To expose the students to evolving real time applications.

UNIT - I: INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO **9**

Evolution of Software Defined Radio and Cognitive Radio: Goals, Benefits, Definitions, Architectures, Relations with other radios, Issues, Enabling technologies, Radio Frequency Spectrum and Regulations. Cognitive techniques – Position awareness, Environment awareness in Cognitive Radios

UNIT - II: COGNITIVE RADIO ARCHITECTURE **9**

Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, SDR as a platform for Cognitive Radio – Hardware and Software Architectures, Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

UNIT - III: NEXT GENERATION WIRELESS NETWORKS **9**

The XG Network architecture, Spectrum sensing, Spectrum management, Spectrum mobility, Spectrum sharing

UNIT - IV: MAC AND NETWORK LAYER DESIGN AND PROTOCOLS FOR COGNITIVE RADIO **9**

MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA,– MAC Protocols for Cognitive Radio infrastructure based networks : Random access protocols, Time slotted protocols, Hybrid protocols - MAC Protocols for CR Adhoc networks : Random access protocols, Time slotted protocols, Hybrid protocols - Network layer design – Routing in cognitive radios, Flow control and error control techniques.

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UNIT - V: ADVANCED TRENDS IN COGNITIVE RADIO 9

Overview of security issues in cognitive radios, Auction based spectrum markets in cognitive radio networks, Public safety and cognitive radio, Cognitive radio for Internet of Things. Cognitive Radio in Wireless Sensor Networks, Applications of machine learning to cognitive radio networks.

TOTAL PERIODS: 45

OUTCOMES:

On Completion of the Course, the student should be able to:

- Gain knowledge on the basic architecture and standards for cognitive radio.
- Analyze the design principles of software defined radio and cognitive radio to develop algorithms for cognitive radio spectrum sensing and dynamic spectrum access.
- Develop the ability to design and implement algorithms to meet the requirements of next generation wireless networks.
- Apply the knowledge of advanced features of cognitive radio for real world applications.
- Explain the real time wireless applications related to cognitive radio.

TEXT BOOKS:

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, “Cognitive Radio Communications and Networks”, Academic Press, Elsevier, 2010.
2. Huseyin Arslan (Ed.), “Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems”, Springer, 2007.

REFERENCE BOOKS:

1. Claudia Cormio, Kaushik R. Chowdhury, “A survey on MAC protocols for cognitive radio networks”, Elsevier AdHoc Networks, February 2009.
2. Gyanendra Prasad Joshi, Seung Yeob Nam, and Sung Won Kim, “Cognitive Radio Wireless Sensor Networks: Applications, Challenges and Research Trends”, Sensors, 2013.
3. Joseph Mitola III, “Software Radio Architecture: Object-Oriented Approaches to Wireless System Engineering”, John Wiley & Sons Ltd. 2000.
4. Bruce A. Fette, “Cognitive Radio Technology”, Elsevier, 2009.
5. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, “Next generation / dynamic spectrum access / cognitive radio wireless networks: A Survey”, Elsevier Computer Networks, May 2006.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	-	-	2	-	-	-	-	3	2	-	-
CO2	3	2	2	-	-	-	-	2	-	-	-	-	3	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	3	3	2	-	-
CO4	3	2	2	1	-	1	1		1	-	-	-	3	3	-	-
CO5	3	2	2	1	-	1	1	2	1	-	-	3	3	3	-	-

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1906804 **MIXED SIGNAL IC DESIGN** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- Study the mixed signal of submicron CMOS circuits.
- Categorize the various integrated based filters and topologies.
- Analyze the data converters architecture, modelling and signal to noise ratio.
- Interpret the integrated circuit of Oscillators, PLL and Sensors.
- Understand the principles of hierarchical mixed signal CMOS VLSI, from the transistor up to the system level.

UNIT - I: SUBMICRON CMOS CIRCUIT DESIGN 9

Submicron CMOS: Overview and Models, CMOS process flow, Capacitors and Resistors. Digital circuit design: The MOSFET Switch, Delay Elements, An Adder. Analog Circuit Design: Biasing, Op-Amp Design, Circuit Noise.

UNIT - II: INTEGRATOR BASED CMOS FILTERS 9

Integrator Building Blocks- low pass filter, Active RC integrators, MOSFET-C Integrators, gm-C integrators, Discrete time integrators. Filtering Topologies: The Bilinear transfer function, The Biquadratic transfer function, Filters using Noise shaping.

UNIT - III: DATA CONVERTER ARCHITECTURES 9

DAC Architectures- Resistor string, R-2R ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, and Pipeline DAC. ADC Architectures- Flash, Two-step flash ADC, Pipeline ADC, Integrating ADC‘s, Successive Approximation ADC.

UNIT - IV: DATA CONVERTER MODELING AND SNR 9

Sampling and Aliasing: A modelling approach, Impulse sampling, the sample and Hold, Quantization noise. Data converter SNR: An overview, Clock Jitter, Improving SNR using Averaging, Decimating filter for ADCs, Interpolating filter for DACs, Band pass and High pass sinc filters - Using feedback to improve SNR.

UNIT - V: OSCILLATORS, PLL AND INTEGRATED SENSORS 9

LC oscillators, Voltage Controlled Oscillators. Simple PLL, Charge pumps PLLs, Non ideal effects in PLLs, Delay Locked Loops. Mechanical Sensors, Thermal Sensors, Humidity sensors, Magnetic sensors.

TOTAL PERIODS: 45

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OUTCOMES:

On completion of the course, the student should be able to,

- Apply the concepts for mixed signal MOS circuit design.
- Exhibit the characteristics of IC based CMOS filters.
- Design of various data converter architecture circuits.
- Analyze the signal to noise ratio and modelling of mixed signals.
- Explore the behaviour of Oscillators, PLL and Sensors.

TEXT BOOKS:

1. R.Jacob Baker, “CMOS Mixed Signal Circuit Design”, Wiley India, IEEE Press, reprint 2008.
2. R.J. Baker, “CMOS Circuit Design, Layout and Simulation”, 3rd Edition, Wiley-Blackwell, 2010.

REFERENCE BOOKS:

1. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 33rd Re-print, 2016.
2. Mohammed Ismail, Terri Fiez, “Analog VLSI Signal and Information Processing”, McGraw-Hill, Inc.
3. Gray, Hurst, Lewis and Meyer, “Analysis and Design of Analog Integrated Circuits”, 5th Edition, Wiley India, 2011.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	1	3	1	-	-	2	2	-	-	-	1	2	1	-	-
CO2	2	1	3	1	-	-	-	-	-	-	-	3	2	2	-	-
CO3	2	1	3	3	-	-	2	2	-	-	-	3	2	1	-	-
CO4	2	-	2	2	-	-	-	-	-	-	-	2	2	1	-	-
CO5	2	2	-	2	-	-	-	-	-	-	-	2	1	2	-	-

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1906004 **ELECTRONICS PACKAGING AND TESTING** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To define the functions of an electronic packaging.
- To review about the electrical issues in packaging.
- To describe the single chip, multi chip and System In Packages.
- To learn about PCB and Surface Mount Technology.
- To identify the type of Testing to be used and Fault Modelling.

UNIT - I: OVERVIEW OF ELECTRONIC SYSTEMS PACKAGING 9

Functions of an Electronic Package, Packaging Hierarchy, IC packaging: MEMS packaging, consumer electronics packaging, medical electronics packaging, Trends, Challenges, Driving Forces on Packaging Technology, Materials for Microelectronic packaging, Packaging Material Properties, Ceramics, Polymers, and Metals in Packaging, Material for high density interconnect substrates.

UNIT - II: ELECTRICAL ISSSUES IN PACKAGING 9

Electrical Issues of Systems Packaging, Signal Distribution, Power Distribution, Electromagnetic Interference, Transmission Lines, Clock Distribution, Noise Sources, Digital and RF Issues. Design Process Electrical Design: Interconnect Capacitance, Resistance and Inductance fundamentals; Packaging roadmaps - Hybrid circuits - Resistive, Capacitive and Inductive parasitic.

UNIT - III: CHIP PACKAGES 9

IC Assembly - Purpose, Requirements, Technologies, Wire bonding, Tape Automated Bonding, Flip Chip, Wafer Level Packaging, reliability, wafer level burn – in and test. Single chip packaging: functions, types, materials processes, properties, characteristics, trends. Multi chip packaging: types, design, comparison, trends. System in - package (SIP); Passives: discrete, integrated, and embedded.

UNIT - IV: PCB, SURFACE MOUNT TECHNOLOGY AND THERMAL CONSIDERATIONS 9

Printed Circuit Board: Anatomy, CAD tools for PCB design, Standard fabrication, Micro via Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges. Thermal Management, Heat transfer fundamentals, Thermal conductivity and resistance, Conduction, convection and radiation – Cooling requirements.

UNIT - V: TESTING **9**

Reliability, Basic concepts, Environmental interactions. Thermal mismatch and fatigue – failures – thermo mechanically induced –electrically induced – chemically induced. Electrical Testing: System level electrical testing, Interconnection tests, Active Circuit Testing, Design for Testability.DSP based Analog and Mixed Signal Testing, Fault Modelling.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- To describe the functions of an electronic packaging.
- To design of packages which can withstand higher temperature, vibrations and shock.
- To identify the type of package.
- Design of PCBs which minimize the EMI and operate at higher frequency.
- To analyse the testing technique.

TEXT BOOKS:

1. Tummala and Rao R, "Fundamentals of Microsystems Packaging", First Edition, McGraw Hill, 2001
2. Michael L. Bushnell and Vishwani D. Agrawal, "Essentials of Electronic Testing for Digital, memory & Mixed signal VLSI Circuits", Kluwer Academic Publishers, 2000.

REFERENCE BOOKS:

1. Blackwell , "The electronic packaging handbook", CRC Press, 2000.
2. Tummala, Rao R, "Microelectronics packaging handbook", McGraw Hill, 2008.
3. Bosshart, "Printed Circuit Boards Design and Technology", TataMcGraw Hill, 1988.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-	-	-	-	1
CO4	2	2	2	-	-	-	-	-	-	-	-	-	2	-	-	-
CO5	3	2	3	-	-	-	-	-	-	-	-	-	-	-	2	-

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SEMESTER VIII

PROFESSIONAL ELECTIVE-V

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1906805	Electro Magnetic Interference and Compatibility	PE	3	3	0	0	3
2.	1906806	Satellite Communication	PE	3	3	0	0	3
3.	1906807	Advanced Wireless Communication	PE	3	3	0	0	3
4.	1906808	Ad Hoc and Wireless Sensor Networks	PE	3	3	0	0	3
5.	1906809	Advanced Microprocessors and Microcontrollers	PE	3	3	0	0	3

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1906805 ELECTRO MAGNETIC INTERFERENCE AND COMPATIBILITY **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the basic concepts of Electromagnetic Interference.
- To impart the knowledge on EMI coupling and control mechanisms.
- To explore importance of Electromagnetic Compatible designs.
- To explain the existing standards for Electromagnetic Compatibility.
- To analyse the various EMI measurement Techniques.

UNIT – I: EMI/EMC CONCEPTS **9**

EMI-EMC definitions; Sources and Victims of EMI; Conducted and Radiated EMI Emission and Susceptibility; Case Histories; Radiation Hazards to humans.

UNIT – II: EMI COUPLING PRINCIPLES **9**

Conducted, Radiated and Transient coupling; Common Ground impedance coupling; Common mode and Ground Loop coupling; Differential mode coupling; Near field Cable to Cable Coupling; Field to Cable Coupling; Power Mains and Power Supply coupling; Transient EMI, ESD.

UNIT – III: EMI CONTROL **9**

Shielding; EMI Filters; Grounding; Bonding; Isolation transformer; Transient suppressors; EMI Suppression Cables.

UNIT – IV: EMC DESIGN FOR CIRCUITS AND PCBS **9**

Noise from Relays and Switches; Nonlinearities in Circuits; Cross talk in transmission line and Cross talk control; Printed Circuit Board (PCB) Design, System Configuration and Design. Component selection and mounting; PCB trace impedance; Routing; Power distribution decoupling; Zoning; Grounding; VIAs; Terminations.

UNIT – V: EMI MEASUREMENTS AND STANDARDS **9**

Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Line impedance stabilization networks; EMI Rx and spectrum analyser, Civilian standards - CISPR, FCC, IEC, EN; Military standards-MIL461E/462.

TOTAL PERIODS: 45

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OUTCOMES:

On completion of the course, the student should be able to

- Identify the various types and mechanisms of Electromagnetic Interference.
- Determine the solution to EMI sources.
- Analyse the EMI problems in PCB level and System level design.
- Describe a suitable EMI mitigation technique.
- Explore the various EMC Standards and methods to measure them.

TEXT BOOKS:

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, New York, 1996.
2. Henry W.Ott., "Noise Reduction Techniques in Electronic Systems", A Wiley Inter Science Publications, John Wiley and Sons, New York, 1988.

REFERENCE BOOKS:

1. C.R.Paul,"Introduction to Electromagnetic Compatibility", John Wiley and Sons, Inc, 1992.
2. Bemhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Ed, Artech house, Norwood, 1986.
3. Don R. J. White Consultant Incorporate, "Handbook of EMI/EMC", Vol I-V, 1988.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	2	-	-	-	-	-	-	-	2	3	3	-	-
CO2	3	3	3	2	-	2	2	2	-	-	-	3	3	2	-	-
CO3	3	3	3	2	-	2	2	2	-	-	-	3	3	2	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	3	3	-	-
CO5	3	3	3	2	-	2	2	2	-	-	-	3	3	3	-	-

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1906806 SATELLITE COMMUNICATION **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the basics of Satellite Orbits.
- Categorize the Satellite segment and Earth segment.
- Analyze the various methods of Satellite link design.
- Observe the Coding methods and Multiple access techniques used in Satellite.
- Explore the various applications of Satellites.

UNIT – I: SATELLITE ORBITS 9

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse-Sub satellite point – Sun transit outage-Launching Procedures - launch vehicles and propulsion.

UNIT – II: SPACE SEGMENT 9

Spacecraft Technology - Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command, Transponders – The Antenna Subsystem.

UNIT – III: SATELLITE LINK DESIGN 9

Basic link analysis, Interference analysis, Rain induced attenuation and interference, Ionospheric characteristics, Link Design with and without frequency reuse.

UNIT – IV: SATELLITE ACCESS AND CODING METHODS 9

Modulation and Multiplexing: Voice, Data, Video, Analog – Digital transmission system, Digital Video Broadcast. Multiple access: FDMA, TDMA, CDMA, Assignment Methods, Coding Schemes.

UNIT – V: SATELLITE APPLICATIONS 9

INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast Satellites (DBS / DTH).

TOTAL PERIODS: 45

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OUTCOMES:

On Completion of the course, the student would be able to:

- Discriminate the satellite orbits.
- Explain about the different segments in Satellite Communication.
- Analyse and the design equations used in Satellite.
- Implement the Coding methods and Multiple Access techniques in Satellite.
- Elaborate the satellite applications in real time.

TEXT BOOKS:

1.Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2006.

2.Timothy, Pratt, Charles, W.Bostain, Jeremy E.Allnutt, "Satellite Communication", 2nd Edition, Wiley Publications, 2002.

REFERENCE BOOKS:

1.Wilbur L.Pritchard, Hendri G. Suyderhoud, Robert A. Nelson, "Satellite Communication Systems Engineering", Prentice Hall/Pearson, 2007.

2.M.Richharia, "Satellite Communication Systems-Design Principles", Macmillan 2003.

3.Bruce R. Elbert, "The Satellite Communication Applications", Hand Book, Artech House Bostan London, 1997.

4.Tri T. Ha, "Digital Satellite Communication", IInd edition, 1990.

5.Emanuel Fthenakis, "Manual of Satellite Communications", Mc Graw Hill Book Co., 1984.

6.Brian Ackroyd, "World Satellite Communication and Earth station Design", BSP professional Books, 1990.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	1	3	-	-	-	-	-	-	-	-	3	3	3	-	-
CO2	3	1	2	2	-	-	-	-	-	-	-	2	3	3	-	-
CO3	2	3	3	2	-	-	-	-	-	-	-	2	3	2	-	-
CO4	3	2	2	3	-	-	-	-	-	-	-	2	3	2	-	-
CO5	3	3	3	2	-	2	2	2	-	-	-	2	3	2	-	-

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1906807 ADVANCED WIRELESS COMMUNICATION L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To expose the students to the requirements of MIMO systems.
- To understand the techniques for improving capacity of wireless channel using MIMO.
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- To analyze the channel impairment mitigation using space-time block and Trellis codes.
- To enhance the knowledge in advancements of MIMO system like layered space time codes, MU-MIMO System and MIMO-OFDM systems.
- To expose the students with emerging applications of millimeter wave communication.

UNIT - I: CAPACITY OF WIRELESS CHANNELS 9

The crowded spectrum, need for high data rate, MIMO systems – Array Gain, Diversity Gain, Data Pipes, Spatial MUX, MIMO System Model. MIMO System Capacity – channel known at the TX, Channel unknown to the TX – capacity of deterministic channels, Random channels and frequency selective channels.

UNIT - II: RADIO WAVE PROPAGATION 9

Radio wave propagation – Macroscopic fading- free space and out door, small scale fading Fading measurements – Direct pulse measurements, spread spectrum correlation channel sounding frequency domain channel sounding, Antenna Diversity – Impact of Antenna Diversity on Capacity on Wireless Communication -Diversity combining methods.

UNIT - III: SPACE TIME BLOCK CODES AND TRELLIS CODES 9

Delay Diversity scheme, Alamoti space time code – Maximum likelihood decoding maximum ratio combining. Transmit diversity space time block codes for real signal constellation and complex signal constellation - decoding of STBC. Space time coded systems, space time code word design criteria, design of space time T C on slow fading channels, design of STTC on Fast Fading channels.

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UNIT - IV: LAYERED SPACE TIME CODES **9**

LST transmitter – Horizontal and Vertical LST receiver – ML Rx, Zero forcing Rx; MMSE Rx, SIC Rx, ZF V-blast Rx- MMSE V-blast Rx, Iterative Rx - capacity of MIMO – OFDM systems - capacity of MIMO multi user systems.

UNIT - V: MILLIMETER WAVE COMMUNICATION **9**

Spectrum regulation, Channel propagation, Hardware technology for mmW systems, architecture and mobility, Beam forming techniques, Beam finding, Physical layer techniques - Duplex scheme and Transmission Scheme.

TOTAL PERIODS: 45

OUTCOMES:

On completion of the Course, the student should be able to:

- Explain the requirements and challenges of MIMO technology.
- Comprehend the significance and role of this course in the present contemporary world.
- Apply the knowledge about the importance of MIMO in today's communication.
- Explore the various methods for improving the channel capacity of wireless communication system.
- Design and Estimate the performance of advanced beam forming techniques in information and communication technology.

TEXT BOOKS:

1. Mohinder Jankiraman, “Space-time codes and MIMO systems”, Artech House, Boston, London. www.artech house.com, ISBN 1-58053-865-7-2004.
2. Paulraj Rohit Nabar, Dhananjay Gore, “Introduction of space time wireless communication systems”, Cambridge University Press, 2003.

REFERENCE BOOKS:

1. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
2. Hamid Jafarkhani, "Space - Time Coding: Theory and Practices”, Cambridge University Press 2005.
3. Mieczyslaw M Kokar, Lezek Lechowicz, "Cognitive Radio Interoperability through Waveform Reconfiguration”, ARTECH House 2016.
4. Sergio Verdu, “Multi User Detection”, Cambridge University Press, 1998.
5. Mischa Dohler, Jose F. Monserrat Afif Osseiran "5G Mobile and Wireless Communication Technology”, Cambridge University Press, 2016.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-
CO2	3	-	2	-	-	2	-	2	-	-	-	2	2	2	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	2	2		2	-
CO4	3	3	1	3	-	2	3	-	-	2	2	3	3	3	3	-
CO5	3	2	1	-	-	2	3	2	3	-	-	3	2	3	3	-

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1906808 AD HOC AND WIRELESS SENSOR NETWORKS

L	T	P	C
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OBJECTIVES:

The student should be made:

- To study the fundamentals of Ad hoc network and Sensor Network.
- To learn the components and to have an in-depth knowledge on sensor network architecture.
- To understand the transport layer protocols possible in Ad hoc and Sensor networks.
- To analyze the security issues of different routing protocols.
- To gain complete knowledge about application of Sensor network and also to have an exposure to programming tools.

UNIT - I: AD HOC NETWORKS – INTRODUCTION AND ROUTING PROTOCOLS 9

Elements of Ad hoc Wireless Networks, Issues in Ad hoc wireless networks, Classifications of Routing Protocols, Destination Sequenced Distance Vector (DSDV), On–Demand Routing protocols –Ad hoc On–Demand Distance Vector Routing (AODV), Opportunistic Routing , Self Configuration and Auto Configuration, Issues in designing a Routing Protocol for Ad Hoc Wireless Networks, Commercial applications of Ad hoc networking.

UNIT - II: SENSOR NETWORK CONCEPTS, ARCHITECTURES AND DESIGN CHALLENGES 9

Network Architecture - Sensor Network Scenarios, Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes, Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks, Transceiver Design Considerations, Optimization Goals and Figures of Merit.

UNIT - III: WSN NETWORKING PROTOCOLS 9

MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC, The Mediation Device Protocol, Contention based protocols - PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols-Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

UNIT - IV: SENSOR NETWORK SECURITY 9

Network Security Requirements, Issues and Challenges in Security Provisioning, Network Security Attacks, Layer wise attacks in wireless sensor networks, possible solutions for jamming, tampering, black hole attack, flooding attack. Key Distribution and Management, Secure Routing – SPINS, reliability requirements in sensor networks.

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UNIT - V: APPLICATIONS OF SENSOR NETWORK AND TOOLS 9

Real time applications of WSN, Node-level Simulators – NS2 and its extension to sensor networks, COOJA, TOSSIM, Programming beyond individual nodes.

TOTAL PERIODS: 45

OUTCOMES:

On completion of the Course, the student should be able to:

- Explain the basics of Ad hoc networks and Wireless Sensor Networks.
- Identify the suitable routing algorithm based on the network and user requirement.
- Apply the knowledge to identify appropriate physical and MAC layer protocols.
- Analyse the transport layer and security issues possible in Ad hoc and sensor networks.
- Explore the concepts of sensor networks for societal applications and become familiar with the tools used in Wireless Sensor Networks.

TEXT BOOKS:

1. C. Siva Ram Murthy and B. S. Manoj, “Ad Hoc Wireless Networks Architectures and Protocols”, Prentice Hall, PTR, 2004.
2. Holger Karl, Andreas Willig, “Protocol and Architecture for Wireless Sensor Networks”, John wiley publication, Jan 2006.

REFERENCE BOOKS:

1. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks: an information processing approach”, Elsevier publication, 2004.
2. Charles E. Perkins, “Ad Hoc Networking”, Addison Wesley, 2000.
3. I.F. Akyildiz, W. Su, Sankarasubramaniam, E. Cayirci, “Wireless sensor networks: a survey”, computer networks, Elsevier, 2002, 394 - 422.
4. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks: Theory and Applications”, 2nd Edition, World Scientific Publishing, 2011.
5. Erdal Çayırcı , Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, John Wiley and Sons, 2009.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	-	1	-	1	-	-	-	-	-	2	2	2	-	-
CO2	3	2	1	1	-	-	-	-	2	2	-	2	2	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	2	2	-	-	-
CO4	3	2	1	1	-	1	-	-	2	2	-	2	3	3	-	-
CO5	3	2	1	2	3	-	2	2	2	2	-	2	2	2	3	3

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1906809	ADVANCED MICROPROCESSORS AND MICROCONTROLLERS	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the architecture and operations of advanced processors.
- To apply the concepts of advanced processors in DSP applications.
- To introduce the embedded operating systems and applications of ARM processors.
- To explain the operating modes of Motorola 68HC11 microcontrollers.
- To demonstrate the architecture, instruction sets and applications of PIC microcontroller.

UNIT – I: HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM 9

CPU Architecture- Bus Operations – Pipelining – Brach predication – floating point unit- Operating Modes –Paging – Multitasking – Exception and Interrupts – Instruction set – addressing modes – Programming the Pentium processor.

UNIT – II: HIGH PERFORMANCE RISC ARCHITECTURE – ARM 9

Arcon RISC Machine – Architectural Inheritance – Core & Architectures - Registers – Pipeline - Interrupts – ARM organization - ARM processor family – Co-processors - ARM instruction set- Thumb Instruction set - Instruction cycle timings - The ARM Programmer's model – ARM Development tools – ARM Assembly Language Programming - C programming – Optimizing ARM Assembly Code – Optimized Primitives.

UNIT – III: ARM APPLICATION DEVELOPMENT 9

Introduction to DSP on ARM –FIR filter – IIR filter – Discrete fourier transform – Exception handling – Interrupts – Interrupt handling schemes- Firmware and bootloader – Embedded Operating systems – Integrated Development Environment- STDIO Libraries – Peripheral Interface – Application of ARM Processor - Caches – Memory protection Units – Memory Management units – Future ARM Technologies.

UNIT – IV: MOTOROLA 68HC11 MICROCONTROLLERS 9

Instruction set addressing modes – operating modes- Interrupt system- RTC-Serial Communication Interface – A/D Converter PWM and UART.

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UNIT – V: PIC MICROCONTROLLER **9**

CPU Architecture – Instruction set – interrupts- Timers- I2C Interfacing –UART- A/D Converter –PWM and introduction to C-Compilers.

TOTAL PERIODS: 45

OUTCOMES:

After studying this course, the student should be able to,

- Describe the features and various functions of advanced microprocessor.
- Analyze the instruction sets and instruction cycle timings of RISC machine.
- Illustrate the memory management unit and applications of ARM processor.
- Determine the operating modes and applications of Motorola 64HC11 microcontroller.
- Interpret the architecture and instruction set of PIC microcontroller.

TEXT BOOKS:

1. Andrew N.Sloss, Dominic Symes and Chris Wright "ARM System Developer‟s Guide: Designing and Optimizing System Software", First edition, Morgan Kaufmann Publishers, 2004.
2. Marilyn Wolf, "Computer as Components: Principles of Embedding Computing System Design", Third Edition Morgan Kaufmann Publisher, 2012.

REFERENCES BOOKS:

1. Steve Furber , "ARM System –On –Chip architecture", Addision Wesley, 2000.
2. Daniel Tabak , "Advanced Microprocessors", Mc Graw Hill. Inc., 1995.
3. James L. Antonakos, "The Pentium Microprocessor", Pearson Education, 1997.
4. Gene .H.Miller, "Micro Computer Engineering", Pearson Education, 2003.
5. John .B.Peatman, "Design with PIC Microcontroller", Prentice Hall, 1997.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	-	-	-	-	-	1	-	2	3	2	-	-
CO2	3	3	3	3	-	-	-	-	-	1	-	2	3	2	-	-
CO3	3	3	3	3	-	-	-	-	-	1	-	2	3	1	-	-
CO4	3	3	3	3	-	-	-	-	-	1	-	2	3	1	-	-
CO5	3	3	3	3	-	-	-	-	-	1	-	2	3	1	-	-

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OPEN ELECTIVE – I (V SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	Course offering Department	CONTACT HOURS	L	T	P	C
1.	1902512	Environment and Agriculture	AGRI	3	3	0	0	3
2.	1902513	Production Technology of Agricultural Machinery	AGRI	3	3	0	0	3
3.	1903514	Air Pollution and Control Engineering	CIVIL	3	3	0	0	3
4.	1903515	Participatory Water Resources Management	CIVIL	3	3	0	0	3
5.	1904504	Geographic Information System	CSE	3	3	0	0	3
6.	1904007	Data Structures	CSE	3	3	0	0	3
7.	1904508	Database management systems	CSE	3	3	0	0	3
8.	1904509	Cloud computing	CSE	3	3	0	0	3
9.	1905001	Energy Conservation and Management	EEE	3	3	0	0	3
10.	1905508	Renewable Energy Sources	EEE	3	3	0	0	3
11.	1905509	SCADA System Management	EEE	3	3	0	0	3
12.	1907503	Sensors and Transducers	EIE	3	3	0	0	3
13.	1907504	Instrumentation in Biomedical Engineering	EIE	3	3	0	0	3
14.	1908001	3D Printing and Design	IT	3	3	0	0	3
15.	1908002	Scripting Languages	IT	3	3	0	0	3
16.	1909510	Product Design and Development	MECH	3	3	0	0	3
17.	1909511	Vibration and Noise Control	MECH	3	3	0	0	3
18.	1909512	Industrial Safety Engineering	MECH	3	3	0	0	3
19.	1910504	Principles of Food Preservation	MEDICAL ELECTRONICS	3	3	0	0	3
20.	1920501	Nanotechnology	PHYSICS	3	3	0	0	3
21.	1920502	Microscopy	PHYSICS	3	3	0	0	3
22.	1921501	Advanced Engineering Chemistry	CHEMISTRY	3	3	0	0	3
23.	1921502	Industrial Nanotechnology	CHEMISTRY	3	3	0	0	3

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1902512 ENVIRONMENT AND AGRICULTURE **L T P C**

3 0 0 3

OBJECTIVES:

- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To understand the ecological context of agriculture and its concerns.
- To study the context of climate change and emerging global issues.
- To gain knowledge on water balance.
- To understand the importance of virtual water.

UNIT-I: ENVIRONMENTAL CONCERNS 9

Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems.

UNIT-II: ENVIRONMENTAL IMPACTS 9

Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts.

UNIT- III: CLIMATE CHANGE 9

Global warming and changing environment – Ecosystem changes – Changing blue-green-grey water cycles – Water scarcity and water shortages – Desertification.

UNIT-IV: ECOLOGICAL DIVERSITY AND AGRICULTURE 9

Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insets and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.

UNIT-V: EMERGING ISSUES 9

Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural environment policies and its impacts – Sustainable agriculture.

TOTAL: 45 PERIODS

OUTCOMES:

- Students may be able to know how the environment and agriculture are related and the changes in the environmental due to agriculture.

- Students will be able to gather idea on about how the mechanization helps and impacts of soil erosion due to agricultural activities.
- Students will have a wide knowledge of changing environment due to global warming and climate change and its impact on water.
- Students are exposed to the ecological diversity in agriculture and different technologies used in farming activities.
- Students are able to understand the global governance system and agricultural policies involved in the sustainable agricultural systems.

TEXT BOOKS:

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.

REFERENCE BOOKS:

1. T.C. Byerly, Environment and Agriculture, United States Dept. of Agriculture, Economic Research Service, 2006.

2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century: proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994.

3. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	2	-	-	-	1	1	-	-	1	-	-	2	2	1	1
CO2	2	3	1	-	2	3	-	-	1	-	1	1	1	1	1	2
CO3	1	3	-	-	-	1	2	-	-	-	-	2	2	2	2	1
CO4	3	3	3	2	3	-	3	2	1	-	2	3	2	1	1	-
CO5	-	3	2	2	3	-	3	3	-	-	2	3	2	2	3	1

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1902513 PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINERY **L T P C 3 0 0 3**

OBJECTIVES:

- To understand the mechanical properties of engineering materials and their classifications
- To understand the basic principles of lathe and the corresponding machines.
- To gain knowledge on various welding techniques available.
- To understand the importance of advanced manufacturing process.
- To emphasize on the importance of accuracy on machine operation.

UNIT- I: ENGINEERING MATERIALS **9**

Engineering materials - their classification - Mechanical properties of materials, strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, toughness, hardness, resilience, machinability, formability, weldability. Steels and cast irons: Carbon steels, their classification based on percentage of carbon as low, mild, medium & high carbon steel, their properties & applications. Wrought iron, cast iron. Alloy steels: Stainless steel, tool steel.

UNIT- II: MACHINING **9**

Basic principles of lathe - machine and operations performed on it. Basic description of machines and operations of Shaper-Planner, Drilling, Milling & Grinding.

UNIT- III: WELDING **9**

Introduction, classification of welding processes. Gas welding, types of flames and their applications. Electric Arc welding. Resistance welding, Soldering & Brazing processes and their uses.

UNIT-IV: ADVANCED MANUFACTURING PROCESS **9**

Abrasive flow machining - abrasive jet machining - water jet machining - Electro Discharge Machining (EDM) - Wire cut EDM - Electro Chemical Machining (ECM) - Ultrasonic Machining / Drilling (USM / USD) - Electron Beam Machining (EBM) - Laser Beam Machining (LBM).

UNIT- V: CNC MACHINE **9**

Numerical control (NC) machine tools - CNC: types, constitutional details, special features - design considerations of CNC machines for improving machining accuracy - structural

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members - slide ways - linear bearings - ball screws - spindle drives and feed drives. Part programming fundamentals - manual programming.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course,

- Students can able to apply the different manufacturing process and use this in industry for component production.
- Students will be able to understand the working principle of lathe and various operations done on it.
- Students will be able to gather idea on welding and soldering process.
- Students will gain wide knowledge on various advance manufacturing process.
- Students will gain knowledge in CNC machine and improving the machining accuracy.

TEXTBOOKS:

1. "Manufacturing Engineering and Technology", Kalpakjian and Schmid, Pearson, 2010.
2. Hajra Choudry, "Elements of workshop technology - Vol II", Media promoters, 2002.

REFERENCE BOOKS:

1. Gupta. K.N., and Kaushik, J.P., 1998, Workshop Technology Vol I and II, New Heights, Daryaganj, New Delhi.
2. Arthur. D., et. al. 1998, General Engineering Workshop Practice, Asia Publishing House, Bombay.
3. Chapman W.A.J., Workshop Technology, 1992, Part I, II, III, E.L.B.S. and Edward Amold Publishers Ltd, London.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	-	2	1	1	3	-	2	-	-	-	2	1	-	2	2
CO2	2	2	-	-	1	2	-	-	2	-	1	-	2	2	-	3
CO3	3	2	-	2	2	-	-	2	-	-	-	-	1	-	3	2
CO4	2	-	2	3	3	-	2	-	2	1	1	2	2	3	-	2
CO5	-	2	-	2	3	-	2	-	3	1	-	-	-	2	2	3

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1903514 AIR POLLUTION AND CONTROL ENGINEERING **L T P C**

3 0 0 3

OBJECTIVE:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.
- To gain knowledge of characteristics of air pollution and noise pollution.
- To create awareness among the sources and effects of air pollution.
- To gain knowledge on air pollution control equipments.
- To develop a knowledge on air quality standards.

UNIT- I: INTRODUCTION 9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards – Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT- II: METEOROLOGY 9

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

UNIT- III: CONTROL OF PARTICULATE CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT- IV: CONTROL OF GASEOUS CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

UNIT- V: INDOOR AIR QUALITY MANAGEMENT 9

Air quality standards - Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness - Town planning regulations of industries-Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

TOTAL: 45 PERIODS

OUTCOMES:

The students completing the course will have

- An understanding of the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management.
- Ability to identify, formulate and solve air and noise pollution problems.
- Ability to design stacks and particulate air pollution control devices to meet applicable standards.
- Ability to select control equipments.
- Ability to control effects of noise pollution and indoor air pollution.

TEXTBOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, springer science , science media LLC,2004.
2. Noel de Nevers, "Air Pollution Control Engineering", Waveland press,Inc 2017.
3. Anjaneyulu. Y, "Air Pollution and Control Technologies", Allied Publishers (P) Ltd., India 2002.

REFERENCE BOOKS:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2000.
2. Arthur C. Stern, "Air Pollution (Vol.I – Vol.VIII)", Academic Press, 2006.
3. Wayne T.Davis, "Air Pollution Engineering Manual", John Wiley & Sons, Inc, 2000.
4. M.N Rao and HVN Rao, "Air Pollution", Tata Mcgraw Hill Publishing Company limited, 2007.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	3	-	-	-	-	-	-	2	-	-	-
CO2	-	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	-	-	2	-	-	-	2	2	-	-	-	-	-	-	-	-
CO4	-	-	-	3	3	-	-	-	-	-	-	-	-	-	-	1
CO5	-	-	-	-	3	-	-	-	2	1	2	2	-	-	3	-

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1903515 PARTICIPATORY WATER RESOURCES MANAGEMENT L T P C

3 0 0 3

OBJECTIVE:

- To gain an insight on local and global perceptions and approaches on participatory water resource management
- To know the role of farmers in socio economic issues and challenges.
- To bring the knowledge of water conservation.
- To gain knowledge on issues of water management.
- To develop knowledge on global challenges and solutions.

UNIT- I: FUNDAMENTALS: SOCIOLOGY AND PARTICIPATORY APPROACH 9

Sociology – Basic concepts – Perspectives- Social Stratification – Irrigation as a Socio technical Process - Participatory concepts– Needs for participatory -Objectives of participatory approach.

UNIT- II: UNDERSTANDING FARMERS PARTICIPATION 9

Farmers participation - Need and Benefits - Comparisons of cost and benefit -Sustained system performance - Kinds of participation - Context of participation, factors in the environment - WUA - Constraints in organizing FA - Role of Community Organizer – socio economic - Case Studies.

UNIT- III: ISSUES IN WATER MANAGEMENT 9

Multiple use of water – Issues in Inter-sectoral Water Allocation - domestic, irrigation, industrial sectors - Modernization techniques and its challenges – Command Area Development - Water delivery systems – Advantages and disadvantages.

UNIT-IV: PARTICIPATORY WATER CONSERVATION 9

Global Challenges -Social – Economic – Environmental - Solutions –Political - Water Marketing –Water Rights -Consumer education – Success Stories Case Studies.

UNIT- V: PARTICIPATORY WATERSHED DEVELOPMENT 9

Concept and significance of watershed - Basic factors influencing watershed development – Principles of watershed management - Definition of watershed management – Identification of problems - Watershed approach in Government programmes –- People's participation – Entry point activities - Evaluation of watershed management measures.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Gain knowledge on various processes involved in participatory water resource management.
- Understand farmer's participation in water resources management.
- Aware of the issues related to water conservation and watershed Development.
- Get knowledge in participatory water conservation.
- Understand concept, principle and approach of watershed management.

TEXT BOOKS:

1. Sivasubramaniyan,K.“Water Management”, SIMRES Publication, Chennai, 2011.
2. Uphoff.N, “Improving International Irrigation management with Farmer Participation– Getting the process Right – Studies in water Policy and Management”, No.11, West view press, Boulder, CO, 1986.
3. Tideman E.M., “Watershed Management”, Omega Scientific Publishers, New Delhi, 1996.

REFERENCE BOOKS:

1. Chambers Robert, “Managing canal irrigation”, Cambridge University Press, 1989.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	-	-	-	-	2	2	-	2	-	-	-
CO2	-	2	-	-	-	2	2	1	3	-	-	-	-	-	2	2
CO3	-	-	2	3	3	-	-	-	-	-	-	2	-	3	2	-
CO4	2	-	-	1	-	-	1		3		2	-	-	-	1	-
CO5	1	-	-		2	-	-	-	-	-	-	2	1	-	-	2

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1904504 GEOGRAPHIC INFORMATION SYSTEM L T P C

3 0 0 3

OBJECTIVES:

- To introduce the fundamentals and components of Geographic Information System.
- To provide details of spatial data structures and input, management and output processes.
- To provide details about raster input data structures.
- To be familiar with network topologies.
- To Analyze data analytics and various applications of GIS.

UNIT - I: FUNDAMENTALS OF GIS 9

Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People, Methods – Proprietary and open source Software - geographical data types - Spatial, Attribute data- types of attributes – scales/ levels of measurements.

UNIT – II: SPATIAL DATA MODELS 9

Database Structures – Relational, Object Oriented – ER diagram - spatial data models – Raster Data Structures – Raster Data Compression - Vector Data Structures - Raster vs Vector ModelsTIN and GRID data models - OGC standards - Data Quality.

UNIT - III: DATA INPUT AND TOPOLOGY 9

Scanner - Raster Data Input – Raster Data File Formats – Vector Data Input –Digitiser – Topology - Adjacency, connectivity and containment – Topological Consistency rules – Attribute Data linking – ODBC – GPS - Concept GPS based mapping.

UNIT - IV: DATA ANALYSIS 9

Vector Data Analysis tools - Data Analysis tools - Network Analysis - Digital Education models - 3D data collection and utilisation.

UNIT - V: APPLICATIONS 9

GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.

TOTAL: 45 PERIODS

OUTCOMES:

This course equips the student to

- Have basic idea about the fundamentals of GIS.
- Understand the types of data models.
- Get knowledge about data input and topology.

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- Gain knowledge on data quality and standards.
- Understand data management functions and data output.

TEXT BOOKS:

1. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction Geographical Information Systems, Pearson Education, 2nd Edition, 2007.

REFERENCE BOOKS:

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2006.
2. Burrough ,Mcdonnell, Lloyd Principles of Geographical Information Systems Third Edition Oxford University Press 2016
3. Pandey Jatin, Geographic Information System , The Energy and Resources Institute, TERI, Jan-2014.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	-	-	2	-	3	-	-	-	-	-	1	2	-	-
CO2	1	-	-	-	3	1	2	-	-	-	-	-	-	-	2	-
CO3	-	-	-	-	-	-	2	-	-	3	-	1	-	1	-	-
CO4	-	-	-	-	-	-	1	-	-	-	3		-	-	-	-
CO5	-	-	-	-	-	-	1	-	-	-	-	2	2	-	-	-

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1904007 **DATA STRUCTURES** **L T P C**

3 0 0 3

OBJECTIVE

- To understand Linear Data structures programs.
- To understand Nonlinear Data structures program
- To have an idea about implementing search techniques.
- To have a better understanding in sorting techniques.
- To understand the various Indexing algorithms.

UNIT I LINEAR DATA STRUCTURES - LIST **9**

Introduction to structure-Abstract Data Types (ADTs) - List ADT - array-based implementation - linked list implementation - singly linked lists- circularly linked lists - applications of lists –Polynomial Manipulation.

UNIT II LINEAR DATA STRUCTURES - STACKS, QUEUES **9**

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

UNIT III NON LINEAR DATA STRUCTURES TREES- GRAPHS **9**

.– Binary Trees – Binary tree representation and traversals – Application of trees: – Graph and its representations – Graph Traversals – Connected components.

UNIT IV SORTING **9**

Selection sort-Insertion sort – Merge sort – Quick sort – Heap sort – Bubble sort- Shell sort – Radix sort.

UNIT V SEARCHING AND INDEXING **8**

Linear Search – Binary Search - Hash tables – Overflow handling – Hash Index – B-Tree Indexing.

TOTAL: 45 PERIODS

OUTCOMES:

- To learn about Linear Data structures
- Ability to describe stack queue and linked list operation
- Ability to analyze algorithms
- To understand about the tree concepts.
- Ability to summarize searching and sorting techniques.

TEXT BOOKS:

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures, Galgotia Book Source, Gurgaon, 1976.
2. Gregory L. Heilman, Data Structures, Algorithms and Object Oriented Programming, Tata Mcgraw-Hill, New Delhi, 2002.

REFERENCE BOOKS:

1. Jean-Paul Tremblay and Paul G. Sorenson, An Introduction to Data Structures with Applications, Second Edition, Tata McGraw-Hill, New Delhi, 1991.
2. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures and Algorithms, Pearson Education, New Delhi, 2006.
3. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, Pearson
4. Education,1997.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	2	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	2	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	2	-	-	-	-	-	-	-	-	-	2	-	-	-
CO5	-	3	-	3	-	-	-	-	-	-	-	-	-	3	-	-

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1904508 **DATABASE MANAGEMENT SYSTEMS** **L T P C**

3 0 0 3

OBJECTIVES:

- To learn the fundamentals of data models and to represent a database system using ER diagrams.
- To study SQL and relational database design.
- To understand the fundamental concepts of transaction processing- concurrency control techniques recovery procedures
- To have an introductory knowledge about Query Processing.
- To analyze the different DB storage like XML,ODMG etc. in distributed environment

UNIT I INTRODUCTION TO DATABASE 9

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping.

UNIT II RELATIONAL DATABASE 9

Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – Embedded SQL– Dynamic SQL.

UNIT III DATABASE DESIGN 9

Functional Dependencies – Non-loss Decomposition -First, Second, Third Normal Forms, Dependency Preservation – Boyce Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT IV TRANSACTION PROCESSING AND CONCURRENCY CONTROL 9

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UN IT V IMPLEMENTATION TECHNIQUES 9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Query optimization using Heuristics and Cost Estimation.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Classify the modern and futuristic database applications based on size and complexity
- Map ER model to Relational model to perform database design effectively
- Write queries using normalization criteria and optimize queries.
- Compare and contrast various indexing strategies in different database systems
- Appraise how advanced databases differ from traditional databases.

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Database System Concepts, Sixth Edition, Tata McGraw Hill, 2011

2. Ramez Elmasri, Sh □kant B. Navathe, —Fundamentals of Database Systems, Sixth Edition Pearson, 2011.

REFERENCE BOOKS:

1. C. J. Date, A.Kannan, S. Swamynathan, —An Introduction to Database Systems‖, Eighth Edition, Pearson Education, 2006.

2. Raghu Ramakrishnan, —Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.

3. G.K.Gupta, "Database Management Systems‖, Tata McGraw Hill, 2011.

Course Outcomes	Program Outcomes												Program Specific Out omes			
	1	2	3		5	6	7		9	10	11	12			3	4
CO1	3	-	3	-	2	-	1	-	-	-	-	-	2	-	-	-
CO2	3	3	-	-	2	-	-	-	-	-	2	-	-	3	-	-
CO3	2	1	-	2	3	-	-	-	-	-	-	-	-	2	-	-
CO4	-	-	2	-	-	1	-	-	2	-	1	-	-	-	2	-
CO5	-	3	-	-	-	-	-	-	2	-	-	-	-	-	-	-

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1904509 CLOUD COMPUTING L T P C

3 0 0 3

OBJECTIVES:

- To understand the concept of cloud computing.
- To appreciate the evolution of cloud from the existing technologies.
- To have knowledge on the various issues in cloud computing.
- To be familiar with the lead players in cloud.
- To appreciate the emergence of cloud as the next generation computing paradigm.

UNIT I INTRODUCTION 9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics.

UNIT II CLOUD ENABLING TECHNOLOGIES 9

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU –Memory – I/O Devices.

UNIT III CLOUD ARCHITECTURE, SERVICES AND STORAGE 9

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3.

UN IT IV RESOURCE MANAGEMENT AND SECURITY IN CLOUD 9

Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods – Global Exchange of Cloud Resources – Security Overview – Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Virtual Machine Security – IAM –Security Standards.

UNIT V CLOUD TECHNOLOGIES AND ADVANCEMENTS 9

Hadoop – Map Reduce –Google App Engine – Programming Environment for Google App Engine –– Amazon Web services-Open Stack – Federation in the Cloud.

TOTAL: 45 PERIODS

OUTCOMES:

On Completion of the course, the students should be able to:

- Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
- Learn the key and enabling technologies that help in the development of cloud.
- Develop the ability to understand and use the architecture of compute and storage cloud,

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service and delivery models.

- Explain the core issues of cloud computing such as resource management and security.
- Be able to install and use current cloud technologies.

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F Ransome, —Cloud Computing: Implementation, Management a d Sec rity, CRC Press, 2017.

REFERENCE BOOKS:

1. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	2	-	-	-	-	-	-	-	-	2	-	-	-
CO2	-	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	2	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	-	-	3	2	-	-	-	-	-	-	-	-	2	-	-	-
CO5	-	-	-	3	3	-	-	-	-	-	-	-	-	-	3	-

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1905001 ENERGY CONSERVATION AND MANAGEMENT **L T P C**

3 0 0 3

OBJECTIVES:

At the end of the course, the student is expected to

- Understand and analyse the energy data of industries.
- Carryout energy accounting and balancing.
- Conduct energy audit and suggest methodologies for energy savings.
- Utilize the available resources in optimal ways
- Understand and analyse of Energy Economics.

UNIT-I: INTRODUCTION 9

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT-II: ELECTRICAL SYSTEMS 9

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT-III: THERMAL SYSTEMS 9

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories.

UNIT-IV: ENERGY CONSERVATION IN MAJOR UTILITIES 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets.

UNIT-V: ECONOMICS 9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Able to analyse the energy data.
- Can carry out energy accounting and balancing.
- Can suggest methodologies for energy savings.
- Can carry out Energy Conservation in Major Utilities.
- Can suggest methodologies for Energy Economics.

TEXTBOOKS:

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.

REFERENCE BOOKS:

1. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilisation” Hemisphere Publ, Washington, 1988.
2. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford,1981.
3. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982.
4. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.
5. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1	-	1	-	3	-	-	-	2	-	-	-	2	-	-
CO2	-	-	2	-	1	-	-	-	2	-	-	1	1	-	3	
CO3	-	1	-	3	-	2	-	-	-	-	-	-	-	1	1	2
CO4	3	-	-	-	-	3	-	2	-	-	2	-	-		1	-
CO5	-	2	-	3	2	-	1	2	-	-	-	2	-	2	-	-

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1905508	RENEWABLE ENERGY SOURCES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT-I: PRINCIPLES OF SOLAR RADIATION 10

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT-II: SOLAR ENERGY COLLECTION 8

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT-III: SOLAR ENERGY STORAGE AND APPLICATIONS 8

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications- solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion.

UNIT-IV: WIND ENERGY 10

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C.Engine operation and economic aspects.

UNIT-V: GEOTHERMAL ENERGY 9

Resources, types of wells, methods of harnessing the energy, potential in India. OCEAN ENERGY: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques, mini-hydel power plants, and their economics. DIRECT ENERGY CONVERSION: Need for DEC, Carnot cycle, limitations, principles of DEC-Magneto Hydro Dynamic power generation.

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TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Understanding the physics of solar radiation.
- Ability to classify the solar energy collectors and methodologies of storing solar energy.
- Knowledge in applying solar energy in a useful way.
- Knowledge in wind energy and biomass with its economic aspects.
- Knowledge in capturing and applying other forms of energy sources like wind, biogas and geothermal energies.

TEXTBOOKS:

1 Rai G.D., “Non-Conventional Energy Sources”, Khanna Publishers, 2011.

2. Twidell & Wier, “Renewable Energy Resources”, CRC Press (Taylor & Francis), 2011.

REFERENCE BOOKS:

1. Tiwari and Ghosal, “Renewable energy resources”, Narosa Publishing House, 2007.
2. Ramesh R & Kumar K.U, “Renewable Energy Technologies”, Narosa Publishing House, 2004.
3. Mittal K M, “Non-Conventional Energy Systems”, Wheeler Publishing Co. Ltd, New Delhi, 2003.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1	-	1	-	3	-	-	-	2	-	-	-	2	-	-
CO2	-	-	2	-	1	-	-	-	2	-	-	1	1	-	3	
CO3	-	1	-	3	-	2	-	-	-	-	-	-	-	1	1	2
CO4	3	-	-	-	-	3	-	2	-	-	2	-	-		1	-
CO5	-	2	-	3	2	-	1	2	-	-	-	2	-	2	-	-

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1905509 SCADA SYSTEM MANAGEMENT

	L	T	P	C
	3	0	0	3

OBJECTIVES:

- To provide knowledge about the SCADA system and its architecture
- To provide knowledge about SCADA system components
- To provide knowledge about SCADA communication protocols
- To provide knowledge about SCADA monitoring and control in power system
- To provide knowledge about SCADA applications in power system

UNIT I INTRODUCTION 9

Evolution of SCADA, SCADA definitions, SCADA Functional requirements and Components, SCADA Hierarchical concept, SCADA architecture, General features, SCADA Applications, Benefits

UNIT II SCADA SYSTEM COMPONENTS 9

Remote Terminal Unit (RTU), Interface units, Human- Machine Interface Units (HMI), Display Monitors/Data Logger Systems, Intelligent Electronic Devices (IED), Communication Network, SCADA Server, SCADA Control systems and Control panels

UNIT III COMMUNICATION 9

SCADA Communication requirements, Communication protocols: Past, Present and Future, Structure of a SCADA Communications Protocol, Comparison of various communication protocols, IEC61850 based communication architecture, Communication media like Fiber optic, PLCC etc. Interface provisions and communication extensions, synchronization with NCC, DCC.

UNIT IV MONITORING AND CONTROL 9

Online monitoring the event and alarm system, trends and reports, Blocking list, Event disturbance recording. Control function: Station control, bay control, breaker control and disconnector control.

UNIT V APPLICATIONS IN POWER SYSTEM 9

Applications in Generation, Transmission and Distribution sector, Substation SCADA system Functional description, System specification, System selection such as Substation configuration, IEC61850 ring configuration, SAS cubicle concepts, gateway interoperability list, signal naming concept. System Installation, Testing and Commissioning.

TOTAL : 45 PERIODS

OUTCOMES:

- This course gives knowledge about SCADA SYSTEM and its architecture
- This course gives knowledge about various system components of SCADA system
- This course gives knowledge about various communication protocols of SCADA system
- This course gives knowledge about SCADA monitoring and control in power system
- This course gives knowledge about SCADA system applications

TEXTBOOKS:

1. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,2004
2. Gordon Clarke, Deon Reynders: Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems, Newnes Publications, Oxford, UK,2004
3 William T. Shaw, Cybersecurity for SCADA systems, PennWell Books, 2006

REFERENCE BOOKS:

1. David Bailey, Edwin Wright, Practical SCADA for industry, Newnes, 2003
2. Michael Wiebe, A guide to utility automation: AMR, SCADA, and IT systems for electric Power, PennWell 1999
4. Dieter K. Hammer, Lonnie R. Welch, Dieter K. Hammer, “Engineering of Distributed Control Systems”, Nova Science Publishers, USA, 1st Edition, 2001

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1		2		3	2		2	1			3		1		
CO2	3			2	3	1									2	
CO3	2			3	3	2	1			3		1			3	3
CO4		2		3	3	2			1		2				1	
CO5					3	1						1	2			

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1907503 **SENSORS AND TRANSDUCERS** **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of measurement technology.
- To learn the applications and working of motion and ranging sensors.
- To explore the latest sensor technologies like MEMS & nano sensors, smart sensors
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT - I INTRODUCTION **9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types.

UNIT - II MOTION, PROXIMITY AND RANGING SENSORS **9**

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer.,– GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT - III FORCE, MAGNETIC AND HEADING SENSORS **9**

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers.

UNIT - IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS **9**

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT - V SIGNAL CONDITIONING and DAQ SYSTEMS **9**

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

TOTAL : 45 PERIODS

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OUTCOMES:

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

- Explain various calibration techniques and signal types for sensors.
- Understand the basic principles of various sensors.
- Illustrate the basic principles of various smart sensors.
- Apply the various sensors in the Automotive and Mechatronics applications
- Implement the DAQ systems with different sensors for real time applications

TEXT BOOKS:

1. Ernest O Doebelin, Dhanesh N.Manik "Measurement Systems – Applications and Design", seventh Edition, McGraw-Hill, 2019.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCE BOOKS:

1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, "Instrumentation for Engineers and Scientists", Oxford Science Publications, 1999.
3. Richard Zurawski, "Industrial Communication Technology Handbook" 2nd edition, CRC Press, 2015.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	2	1	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	3	2	-	-	-	-	1	-	-	-	-
CO4	-	-	-	-	-	2	2	-	-	-	-	1	-	-	-	-
CO5	3	2	2	2	2	-	-	-	-	-	-	1	-	-	-	-

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1907504 INSTRUMENTATION IN BIOMEDICAL ENGINEERING **L T P C**

3 0 0 3

COURSE OBJECTIVES:

- To study about the different bio potential and its propagation
- To understand the different types of electrodes and its placement for various recording
- To study the design of bio amplifier for various physiological recording
- To learn the different measurement techniques for non-physiological parameters.
- To familiarize the different biochemical measurements.

UNIT - I BIO POTENTIAL GENERATION AND ELECTRODES TYPES **9**

Origin of bio potential and its propagation. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes

UNIT - II BIOSIGNAL CHARACTERISTICS AND ELECTRODECONFIGURATIONS **9**

Biosignals characteristics – frequency and amplitude ranges. ECG – Einthoven's triangle, standard 12 lead system. EEG – 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode.

UNIT - III SIGNAL CONDITIONING CIRCUITS **9**

Need for bio-amplifier - differential bio-amplifier, Impedance matching circuit, isolation amplifiers, Power line interference, Right leg driven ECG amplifier, Band pass filtering

UNIT - IV MEASUREMENT OF NON-ELECTRICALPARAMETERS **9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure: indirect methods - Auscultatory method, direct methods: electronic manometer, Systolic, diastolic pressure, Blood flow and cardiac output measurement: Indicator dilution, and dye dilution method, ultrasound blood flow measurement.

UNIT - V BIO-CHEMICAL MEASUREMENT **9**

Blood gas analyzers and Non-Invasive monitoring, colorimeter, Sodium Potassium Analyser, spectrophotometer, blood cell counter, auto analyzer (simplified schematic description).

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

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

- Understand the different bio potential and its propagation.
- Explain the different electrode placement for various physiological recording
- Design bio amplifier for various physiological recording
- Understand various technique of non-electrical physiological measurements
- Understand the different biochemical measurements

TEXT BOOKS:

1. Leslie Cromwell, “Biomedical Instrumentation and measurement”, Prentice hall of India, New Delhi, 2007.
2. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, New York, 2004.

REFERENCE BOOKS:

1. Myer Kutz, “Standard Handbook of Biomedical Engineering and Design”, McGraw Hill Publisher, 2003.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2003.
3. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, Pearson Education, 2004.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-
CO3	3	1	2	1	1	1	-	-	-	-	-	-	-	-	-	-
CO4	-	-	2	1	1	1	-	-	-	-	-	-	-	-	-	-
CO5	-	-	2	1	1	1	-	-	-	-	-	-	-	-	-	-

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1908001 3D PRINTING AND DESIGN L T P C

3 0 0 3

OBJECTIVES:

- The course is designed to impart knowledge and skills related to 3D printing technologies.
- Selection of material and equipment and develop a product using this technique.
- To understand Industry 4.0 environment.
- To understand CAD and Additive manufacturing
- To understand Additive Equipment.

UNIT - I: 3D PRINTING AND ADDITIVE MANUFACTURING 9

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications.

UNIT - II: CAD AND ADDITIVE MANUFACTURING 9

CAD for Additive Manufacturing-CAD Data formats, Data translation, Data loss, STL format. Additive Manufacturing Techniques - Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology.

UNIT - III: PROCESS 9

Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools

UNIT - IV: MATERIALS 9

Polymers, Metals, Non-Metals, Ceramics, Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. Support Materials.

UNIT - V: ADDITIVE MANUFACTURING EQUIPMENT 9

Process Equipment- Design and process parameters-Governing Bonding Mechanism-Common faults and troubleshooting - Process Design- Post Processing: Requirement and Techniques- Product Quality.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Develop CAD models for 3D printing.
- Import and Export CAD data and generate .stl file.
- Select a specific material for the given application.
- Select a 3D printing process for an application.
- Produce a product using 3D Printing or Additive Manufacturing (AM).

TEXT BOOKS:

1. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies:
   Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”, Hanser Publisher, 2011.

REFERENCE BOOKS:

1. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi. CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping-Principles andApplications”, World Scientific, 2017.
2. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013.
3. L. Lu, J. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”, Kulwer Academic Press, 2001.
4. Zhiqiang Fan And Frank Liou, “Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy”, InTech, 2012.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	-	-	3		2	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	3	-	-	-	-	-	-	-	-	-	-	2	-
CO 3	2	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-
CO 4	-	2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO 5	-	-	-	-	2	-	-	-	3	-	-	-	-	-	2	-

1908002	SCRIPTING LANGUAGES	L T P C
		3 0 0 3

OBJECTIVES:

- The principles of scripting languages.
- Difference between scripting languages and non- scripting languages.
- Types of scripting languages.
- Scripting languages such as PERL, TCL/TK, python and BASH.
- Creation of programs in the Linux environment and usage of scripting languages in IC design flow.

UNIT - I: LINUX BASICS 9

Introduction to Linux , File System of the Linux, General usage of Linux kernel & basic commands, Linux users and group, Permissions for file, directory and users, searching a file & directory, zipping and UNZIPPING CONCEPTS.

UNIT - II: LINUX NETWORKING 9

Introduction to Networking in Linux, Network basics & Tools, File Transfer Protocol in Linux, Network file system, Domain Naming Services, Dynamic hosting configuration Protocol & Network information Services.

UNIT - III: PERL SCRIPTING 9

Introduction to Perl Scripting, working with simple values, Lists and Hashes, Loops and Decisions, Regular Expressions, Files and Data in Perl Scripting, REFERENCE BOOKS: & Subroutines, Running and Debugging Perl, Modules, Object – Oriented Perl.

UNIT - IV: TCL / TK SCRIPTING 9

Tcl Fundamentals, String and Pattern Matching, Tcl Data Structures, Control Flow Commands, Procedures and Scope, Evel, Working with Unix, Reflection and Debugging, Script Libraries, Tk Fundamentals, Tk by examples, The Pack Geometry Manager, Binding Commands to X Events, Buttons and Menus, Simple Tk Widgets, Entry and List box Widgets Focus, Grabs and Dialogs.

UNIT - V: PYTHON SCRIPTING 9

Introduction to Python, using the Python Interpreter, More Control Flow Tools, Data Structures, Modules, Input and Output, Errors and Exceptions, Classes, Brief Tour of the Standard Library.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Create and run scripts using PERL in IC design flow.
- Create and run scripts using TCl in IC design flow
- Create and run scripts using Python in IC design flow
- Use Linux environment and write programs for automation of scripts in VLSI tool design flow.
- Usage of scripting languages in IC design flow.

TEXT BOOKS:

1. Python Tutorial by Guido Van Rossum, Fred L. Drake Jr. editor , Release 2.6.4
2. Practical Programming in Tcl and Tk by Brent Welch, Updated for Tcl 7.4 and Tk4.0.
3. Teach Yorself Perl in 21 days by David Till.
4. Red Hat Enterprise Linux 4 : System Administration Guide Copyright, 2005 Red Hat Inc.

REFERENCE BOOKS:

1. Learning Python – 2nd Ed., Mark Lutz and David Ascher, 2003, O'Reilly.
2. Perl in 24 Hours – 3rd Ed., Clinton Pierce, 2005, Sams Publishing.
3. Learning Perl – 4th Ed. Randal Schwartz, Tom Phoenix and Brain d foy. 2005.
4. Jython Essentials – Samuele Pedroni and Noel Pappin.2002. O'Reilly.
5. Programming Perl – Larry Wall, Tom Christiansen and John Orwant, 3rd Edition, O'Reilly, 2000. (ISBN 0596000278)

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO 3	-	2	3	-	3	-	-	-	-	-	-	-	3	3	-	-
CO 4	-		3	-	-	-	-	-	3	-	-	-	-	3	-	-
CO 5	-	2	-	-	-	3	-	-	-	-	-	-	3	3	-	-

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1909510 PRODUCT DESIGN AND DEVELOPMENT

	L	T	P	C
	3	0	0	3

OBJECTIVES:

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

- Product design and development
- Apply the concept of prototyping in a real life problem.
- Reduce the waste by using product architecture**.**
- Understand the concepts of industrial design.
- Understand the concepts of DFM

UNIT-I: INTRODUCTION 9

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements.

UNIT-II: CONCEPT GENERATION AND SELECTION 9

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT-III: PRODUCT ARCHITECTURE 9

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions

UNIT-IV: INDUSTRIAL DESIGN 9

Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT-V: DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT **9**

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis.

TOTAL : 45 PERIODS

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

- Product design and development
- Apply the concept of prototyping in a real life problem.
- Reduce the waste by using product architecture**.**
- Understand the concepts of industrial design.
- Understand the concepts of DFM

TEXTBOOKS:

1. Kari T.Ulrich and Steven D.Eppinger, “Product Design and Development”, McGraw-Hill International Edn.2017.
2. Product Design and Manufacturing – 2011 by Chitale A. K. , Gupta R. C.

REFERENCE BOOKS:

1. Kemnneth Crow, “Concurrent Engg./Integrated Product Development”, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, “Effective Product Design and Development”, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, Tool Design -Integrated Methods for Successful Product Engineering, Addison Wesley Publishing, New york, NY 2008.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	1	1	-	-	-	1	-	1	-	1	-	-	1	1
CO2	1	1	1	1	1	-	1	1	-	1	-	-	-	-		1
CO3	1	-	-	-	1	1	1	1	1	1	-	1	-	-	1	1
CO4	1	1	1	-	-	-	1	1	-	1	-	-	-	-	1	1
CO5	2	2	-	-	-	-	1	-	-	1	-	-	1	-	-	-

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1909511	VIBRATION AND NOISE CONTROL	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

- Apply the fundamental concepts of vibration.
- Apply the fundamentals of noise.
- Describe the various sources of noise for automotive applications.
- Determine the natural frequencies and mode shapes of the two degree freedom systems.
- Describe the different types of noise and its control measures

UNIT-I: BASICS OF VIBRATION 9

Introduction, classification of vibration: free and forced vibration, undamped and damped vibration, linear and non linear vibration, response of damped and undamped systems under harmonic force, analysis of single degree and two degree of freedom systems, torsional vibration, determination of natural frequencies

UNIT-II: BASICS OF NOISE 9

Introduction, amplitude, frequency, wavelength and sound pressure level, addition, subtraction and averaging decibel levels, noise dose level, legislation, measurement and analysis of noise, measurement environment, equipment, frequency analysis, tracking analysis, sound quality analysis.

UNIT-III: AUTOMOTIVE NOISE SOURCES 9

Noise Characteristics of engines, engine overall noise levels, assessment of combustion noise, assessment of mechanical noise, engine radiated noise, intake and exhaust noise, engine necessary contributed noise, transmission noise, aerodynamic noise, tire noise, brake noise.

UNIT-IV: CONTROLTECHNIQUES 9

Vibration isolation, tuned absorbers, un-tuned viscous dampers, damping treatments, application dynamic forces generated by IC engines, engine isolation, crank shaft damping, modal analysis of the mass elastic model shock absorbers.

UNIT-V: SOURCE OF NOISE AND CONTROL 9

Methods for control of engine noise, combustion noise, mechanical noise, predictive analysis, palliative treatments and enclosures, automotive noise control principles, sound in enclosures, sound energy absorption, sound transmission through barriers.

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TOTAL : 45 PERIODS

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

- Apply the fundamental concepts of vibration.
- Apply the fundamentals of noise.
- Describe the various sources of noise for automotive applications.
- Determine the natural frequencies and mode shapes of the two degree freedom systems.
- Describe the different types of noise and its control measures

TEXTBOOKS:

1. Ambekar. A. G., Mechanical Vibrations and Noise Engineering", Prentice Hall of India Pvt. Ltd., 2006.
2. Singiresu S.Rao, "Mechanical Vibrations", 6th Edition, Pearson Education, 2016

REFERENCE BOOKS:

1. Benson H. Tongue, "Principles of Vibrations", Oxford University, 2007.
2. David A. Bies and Colin H. Hansen, "Engineering Noise Control – Theory and Practice", Spon Press, 2009.
3. Grover. G.K., "Mechanical Vibrations", Nem Chand Bros., 2014.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	2	2	-	-	1	-	-	-	-	1	2	2	-	-
CO2	3	2	2	2	-	-	1	-	-	-	-	1	2	2	-	-
CO3	3	2	2	2	-	-	1	-	-	-	-	1	2	2	-	-
CO4	3	2	2	2	-	-	1	-	-	-	-	1	2	2	-	-
CO5	3	2	2	2	-	-	1	-	-	-	-	1	2	2	-	-

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1909512	INDUSTRIAL SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

- Identify unsafe conditions and recognize unsafe alerts.
- Interpret the rules and regulations for safety operations.
- Capable of solving problem of accidents.
- Capable of solving the present for criticizing the present for improved safety.
- Collaborate and modify processes / procedures for safety.

UNIT-I: INTRODUCTION 9

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT-II: CHEMICAL HAZARDS 9

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT-III: ENVIRONMENTAL CONTROL 9

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT-IV: HAZARD ANALYSIS

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT-V: SAFETY REGULATIONS 9

Explosions – Disaster management – catastrophe control, hazard control , Factories Act, Safety regulations Product safety – case studies.

TOTAL : 45 PERIODS

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

- Identify and prevent chemical, environmental mechanical, fire hazard.
- Collect, analyze and interpret the accidents data based on various safety techniques.
- Apply proper safety techniques on safety engineering and management.
- Able to perform hazard analysis.
- Aid to design the system with environmental consciousness by implementing safety regulation.

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TEXTBOOKS:

1. John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.
2. Krishnan N.V, “Safety in Industry”, Jaico Publisher House, 1996.

REFERENCE BOOKS:

1. David L.Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
2. Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005
3. Safety Manual, “EDEL Engineering Consultancy”, 2000.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	2	-	-	2	1	-	-	-	-	1	1	1	-	-
CO2	2	1	2	-	-	2	1	-	-	-	-	1	1	1	-	-
CO3	2	1	2	-	-	2	1	-	-	-	-	1	1	1	-	-
CO4	2	1	2	-	-	2	1	-	-	-	-	1	1	1	-	-
CO5	2	1	2	-	-	2	1	-	-	-	-	1	1	1	-	-

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1910504 PRINCIPLES OF FOOD PRESERVATION **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To learn about the shelf life of food products.
- To gain knowledge on the storage of food products.
- To know about the thermal processing methods of food.
- To design different types of Dryers.
- To understand the non-thermal methods of food preservation.

UNIT - I: FOOD PRESERVATION AND ITS IMPORTANCE 9

Introduction to food preservation, Wastage of processed foods; Shelf life of food products; Types of food based on its perishability, Traditional methods of preservation.

UNIT - II: METHODS OF FOOD HANDLING AND STORAGE 9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods. Retort pouch packing, Aseptic packaging.

UNIT - III: THERMAL METHODS 9

Newer methods of thermal processing; batch and continuous; In container sterilization-canning; application of infra-red microwaves; ohmic heating; control of water activity; preservation by concentration and dehydration; osmotic methods.

UNIT - IV: DRYING PROCESS FOR TYPICAL FOODS 9

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychometric chart, freezing and cold storage, freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and cold storages.

UNIT - V: NON-THERMAL METHODS 9

Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Aware of the different methods applied to preserving foods.
- Explain the food handling and storage processes.
- Analyze the thermal processing and osmotic methods.
- Explore the drying process of foods.
- Apply the non-thermal methods for food preservation.

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund, “Physical Principles of Food Preservation”, Second Edition, Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M, “Food Preservation and Safety Principles and Practice”, Surbhi Publications, 2001.
3. Sivasankar B, “Food Processing & Preservation”, Prentice Hall of India, 2002.
4. Neelam Khetarpaul, “Food Processing and Preservation”, Daya Publishing House, A division of Astral International (P) Ltd., 2015.

REFERENCE BOOKS:

1. Shafiur M Rahman, “Handbook of Food Preservation”, Second Edition, CRC Press, 2007.
2. Zeuthen Peter, Bogh-Sorensen Leif, “Food Preservation Techniques”, Wood Head Publishing, Cambridge, England, 2005.
3. Ranganna S, “Handbook of Canning and Aseptic Packaging”, Tata McGraw-Hill, 2000.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	3	-	1	1	-	-	-	-	-	2	2	-	2
CO2	2	3	1	2	-	-	-	2	-	-	-	2	2	3	-	3
CO3	3	2	1	2	-	1	1	-	-	-	-	2	1	3	2	-
CO4	3	2	1	2	-	1	1	-	-	-	-	2	1	3	-	-
CO5	3	1	2	-	-	1	1	-	-	-	-	2	-	3	-	1

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1920501 **NANOTECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

- Make the students to understand the fundamentals of nanomaterials.
- To acquire the knowledge on different classifications in nano materials.
- To educate the different synthesis techniques.
- To provide information on different fabrication and characterization techniques.
- Make the students to understand and apply the techniques to different systems.

UNIT -I: BASICS OF NANOTECHNOLOGY 9

Introduction –Scientific revolutions –Time and length scale in structures –Definition of a nanosystem –Dimensionality and size dependent phenomena –Surface to volume ratio -Fraction of surface atoms-Properties at nano scale (optical, mechanical, electronic and magnetic).

UNIT- II:DIFFERENT CLASSES OF NANOMATERIALS 9

Classification based on dimensionality-Quantum Dots, Wells and Wires-Carbon-based nano materials (buckyballs, nanotubes, graphene)–Metal based nano materials (nanogold, nanosilver and metal oxides) –Nanocomposites-Nanopolymers –Nanoglasses –Nano ceramics.

UNIT-III: SYNTHESIS OF NANOMATERIALS 9

Classification of synthesis: Top down and bottom up nanofabrication. Chemical Methods: Solvothermal Synthesis-Photochemical Synthesis –Sonochemical Routes-Chemical Vapor Deposition (CVD) –Metal Oxide -Chemical Vapor Deposition (MOCVD). Physical Methods: Ball Milling –Electrodeposition -Spray Pyrolysis -Flame Pyrolysis - DC/RF Magnetron Sputtering -Molecular Beam Epitaxy (MBE).

UNIT-IV: FABRICATION AND CHARACTERIZATION OF NANOSTRUCTURES 9

Nanofabrication: Photolithography and its limitation-Electron-beam lithography (EBL)-Nanoimprint –Softlithography patterning. Characterization: Environmental Scanning Electron Microscopy (ESEM) High Resolution Transmission Electron Microscope (HRTEM) –Scanning Tunneling Microscope (STM)-Surface enhanced Raman spectroscopy (SERS)-X-ray Photoelectron Spectroscopy (XPS) -Auger electron spectroscopy (AES).

UNIT-V:APPLICATIONS 9

Solar energy conversion and catalysis -Molecular electronics and printed electronics – Nanoelectronics -Polymers with a special architecture -Liquid crystalline systems -optical properties, Applications in displays and other devices -Photonics, Plasmonics-Chemical and biosensors –Nanomedicine and Nanobiotechnology –Nanotoxicology challenges.

TOTAL: 45 PERIODS

OUTCOMES

- Able to understand the basics of nanoscience.
- Able to differentiate the materials based on their structures.
- Ability to understand the different synthesis techniques of nanomaterials.
- Ability to identify various fabrication techniques and characterization of nanostructures.
- Able to apply them for suitable applications.

TEXT BOOKS:

1. Bhusan, Bharat (Ed), "Springer Handbook of Nanotechnology", 2nd Edition, 2007.
2. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002.
3. Pradeep T., "A Textbook of Nanoscience and Nanotechnology", Tata McGraw Hill Education Pvt. Ltd., 2012.

REFERENCE BOOKS:

1. Charles P. Poole Jr., Frank J. Ownes, 'Introduction to Nanotechnology", Wiley Interscience, 2003.
2. Dupas C., Houdy P., Lahmani M., "Nanoscience: Nanotechnologies and Nanophysics",Springer-Verlag Berlin Heidelberg, 2007.
3. Mark Ratner and Daniel Ratner, "Nano Technology", Pearson Education, New Delhi, 2003.
4. Nabok A., "Organic and Inorganic Nanostructures", Artech House, 2005.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	3	3	3	1	-	-	-	-	-	1	3	1	-	
CO2	2	-	3	3	3	-	-	-	-	-	-	1	3	1	-	-
CO3	2	-	3	3	3	-	-	-	-	-	-	1	3	1	-	-
CO4	2	-	3	3	3	1	1	-	-	-	-	1	3	1	-	-
CO5	3	-	3	3	3	1	1	-	-	-	-	1	3	1	-	-

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1920502 **MICROSCOPY** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the basic principles of optical and electron microscopy.
- To elucidate the different microscopic techniques.
- To explore the knowledge on electron microscopy
- Make the students to learn the sample preparation techniques for the micro structural analysis.
- To investigate on different chemical analysis techniques.

UNIT- I: INTRODUCTION 9

History of Microscopy, Overview of current microscopy techniques. Light as particles and waves, Fundamental of optics: Diffraction and interference in image formation, real and virtual images, Resolution, Depth of field and focus, Magnification, Numerical apertur e, Aberration of lenses. Components of Light Microscopy, Compound light microscopy and its variations**.**

UNIT- II: MICROSCOPY 9

Phase contrast microscopy: optical design, theory, image interpretation, Dark-field microscopy: optical design, theory, image interpretation, Polarization Microscopy: Polarized light, optical design, theory, image interpretation, Differential Interference Contrast (DIC): equipment and optics, image interpretation, Modulation contrast microscopy: contrast methods using oblique illumination.

UNIT- III: ELECTRON MICROSCOPY 9

Interaction of electrons with matter, elastic and inelastic scattering, secondary effects, Components of electron microscopy: Electron sources, pumps and holders, lenses, apertures, and resolution. Scanning Electron and Transmission Electron Microscopy: Principle, construction, applications and limitations.

UNIT- IV: SAMPLE PREPARATION FOR MICROSTRUCTURAL ANALYSIS9

Optical Microscopy sample preparation: Grinding, polishing and etching, SEM sample preparation: size constrains, TEM sample preparation: Disk preparation, electro polishing, ion milling, lithography, storing specimens.

UNIT-V: CHEMICAL ANALYSIS 9

Surface chemical composition (Principle and applications) - Mass spectroscopy and X-ray

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emission spectroscopy - Energy Dispersive Spectroscopy- Wave Dispersive Spectroscopy. Electron spectroscopy for chemical analysis (ESCA), X ray Photoelectron Spectroscopy (XPS), Auger Electron Spectroscopy (AES)- Applications.

TOTAL: 45 PERIODS

OUTCOMES

- Able to understand the physics behind the microscopy.
- Ability to describe the principle, construction and working of light microscopy.
- Ability to describe electron microscopy.
- Ability to understand about the important of sample preparation technique.
- Ability to identify the appropriate spectroscopy technique for chemical analysis.

TEXT BOOKS:

1. Douglas B. Murphy, Fundamentals of light microscopy and electronic imaging, 2001, Wiley- Liss, Inc. USA
2. David B. Williams and C. Barry Carter, Transmission Electron Microscopy-A Textbook for Materials Science, Springer US, 2nd edition, 2009.

REFERENCE BOOKS:

1. Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA,1986.
2. Whan R E (Ed), ASM Handbook, Volume 10, Materials Characterization", Ninth Edition, ASM international, USA, 1986.
3. Thomas G., "Transmission electron microscopy of metals", John Wiley, 1996.

CO - PO MAPPING

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	2	1	1	1	1	-	-	-	1	1	1	-	-	-
CO2	2	2	2	1	2	-	1	-	-	-	-	1	1	-	-	1-
CO3	3	3	2	-	3	2	-	-	-	-	-	1	1	1	-	1
CO4	3	2	3	1	3	2	-	-	-	-	-	1	-	2	-	1
CO5	3	3	2	2	3	2	-	-	-	-	1	1	1	1	2	1

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1921501 ADVANCED ENGINEERING CHEMISTRY L T P C

3 0 0 3

OBJECTIVES

- To make the students conversant with basics of polymer chemistry.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To develop and understand the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.

UNIT-I: POLYMERS AND SPECIALITY POLYMER 9

Polymers – Types of polymerization – Degree of polymerization – Plastics and types – Mechanism of polymerization (free radical mechanism) properties of polymers - T_g and tacticity – Compounding of plastics – Fabrication of plastics – Blow and extrusion mouldings. Speciality polymers-Conducting polymers: Polyacetylene, polyaniline, synthesis, mechanism of conduction – Applications of conducting polymers. Bio-degradable polymers: Requirements, factors affecting degradation – PLA– preparation, properties –applications.

UNIT-II: ENERGY SOURCES AND STORAGE DEVICES 9

Solar energy conversion – Solar cells: Types – Wind energy. Batteries: Types of batteries – Primary battery (alkaline battery), secondary battery (lead acid battery, NICAD battery, lithium, lithium-ion & lithium-sulphur battery), fuel cells – H_2-O_2 fuel cell.

UNIT-III: PHOTOCHEMISTRY & ANALYTICAL TECHNIQUES 9

Photochemistry: Laws of photochemistry - Grothuss–Draper law, Stark–Einstein law and Beer-Lambert's Law. Quantum efficiency – determination - Photophysical processes (Jablonski diagram) - photosensitization - Chemiluminescence and bioluminescence. Analytical techniques: IR, UV – principle, Instrumentation and applications. Thermal analysis: TGA & DTA - principle, instrumentation and applications. Chromatography: Basic principles of column & TLC – principles and applications.

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UNIT-IV: THERMODYNAMICS 9

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; Entropy of phase transitions; Clausius inequality. Free energy and work function- Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore.

UNIT-V: PHASE RULE AND ALLOYS 9

Phase rule: Introduction, definition of terms with examples, One component system -Water system – Reduced phase rule – Thermal analysis and cooling curves – Two component systems – Lead-silver system – Pattinson process, Zn-Mg System. Alloys: Introduction-Definition- properties of alloys- Significance of alloying, functions and effect of alloying elements- Nichrome and stainless steel (18/8) – heat treatment of steel.

Total Periods: 45

OUTCOMES

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

- Gain knowledge on polymer chemistry and its developments.
- Understand the process of advanced energy storage devices.
- Analyze the materials using spectroscopic techniques.
- Explain the various state of thermodynamics.
- Outline the nature of alloys by drawing phase rule.

TEXT BOOKS:

1. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, 2016.
2. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2015.
3. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd., 2012.

REFERENCE BOOKS:

1. P. C. Jain and Monika Jain, "Engineering Chemistry" Dhanpat Rai Publishing Company (P) LTD, New Delhi, 2019.
2. S. S. Dara and S. S. Umare, "A Textbook of Engineering Chemistry", S. Chand & Company LTD, New Delhi, 2015.
3. B. K. Sharma, "Engineering Chemistry", Krishna Prakashan Media (P) Ltd, Meerut, 2012.

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Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	1	1	-	1	1	-	-	-	-	1	1	-	-	-	-
CO2	3	2	1	2	1	1	-	-	-	-	1	1	-	-	-	-
CO3	2	1	1	-	2	1	-	-	-	-	2	2	-	-	-	-
CO4	1	1	1	-	-	1	-	-	-	-	1	1	-	-	-	-
CO5	2	1	1	1	2	-	-	-	-	-	1	1	-	-	-	-

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1921502 INDUSTRIAL NANOTECHNOLOGY L T P C

3 0 0 3

OBJECTIVES

- To elucidate on advantages of nanotechnology based applications in each industry
- To provide instances of contemporary industrial applications of nanotechnology
- To provide an overview of future technological advancements and increasing role of nanotechnology in each industry
- To provide an awareness on the nanomaterial synthesis for electronic materials
- To make the student conversant with the latest characterization techniques

UNIT-I: NANO ELECTRONICS 9

Micro and Nanoelectromechanical systems – Sensors, Actuators, Data memory –Lighting and Displays – Applications of piezoelectric and ferroelectric materials- Nano for energy systems - Fuel cells and Photo-voltaic cells – Electric double layer capacitors – Nanoparticle coatings for electrical products.

UNIT-II: BIONANOTECHNOLOGY 9

Nanoparticles in bone substitutes and dentistry – Implants and Prosthesis – Nanorobotics in Surgery –Nanosensors in Diagnosis– Neuro-electronic Interfaces– Therapeutic applications

UNIT-III: NANOTECHNOLOGY IN CHEMICAL INDUSTRY 9

Nanocatalyts – Smart materials – Heterogenous nanostructures and composites – Nanostructures for Molecular recognition (Quantum dots, Nanorods, Nanotubes) – Molecular Encapsulation and its applications – Nanoporous zeolites – Self-assembled Nanoreactors

UNIT-IV: NANOTECHNOLOGY IN AGRICULTURE AND FOOD TECHNOLOGY 9

Nanotechnology in Agriculture -Precision farming, Smart delivery system – Insecticides using nanotechnology – Potential of nano-fertilizers - Nanotechnology in Food industry

UNIT-V: CHARACTERIZATION TECHNIQUES 9

X-ray Diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including High-resolution imaging, Surface Analysis techniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation.

Total Periods: 45

OUTCOMES

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

- Analyze the nanoparticle coatings for electrical products.
- Define various therapeutic applications of bio-nanotechnology.
- Explain the process of molecular encapsulation and nanoreactors.
- Ability to understand the uses of nanotechnology in food industry.
- Outline the nanofiber production and formulation of gels.

TEXTBOOKS:

1. V.A. Rai and J.A. Bai, Nanotechnology Applications in the Food Industry, CRC Press, 2018.
2. S. Thomas, Y. Grohens and Y.B. Pottathara, Industrial Applications of Nanomaterials, Elsevier Press, 2019.
3. N John Dinardo, Nanoscale Characterization of surfaces & Interfaces, 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCE BOOKS:

1. Neelina H. Malsch, Biomedical Nanotechnology, CRC Press, 2005.
2. Udo H. Brinker, Jean-Luc Mieusset, Molecular Encapsulation: Organic Reactions in Constrained Systems, Wiley Publishers, 2010.
3. Jennifer Kuzma and Peter VerHage, Nanotechnology in Agriculture and Food Production, Woodrow Wilson International Center, 2006.
4. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, 2007.
5. Y-W. Mai, Polymer Nano composites, Woodhead Publishing Limited, 2006.
6. W.N. Chang, Nanofibres fabrication, performance and applications, Nova Science Publishers Inc, 2009.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	3	1	1	1	-	-	-	-	2	2	-	-	-	-
CO2	2	2	1	1	1	1	-	-	-	-	1	2	-	-	-	-
CO3	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO4	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO5	2	1	1	1	1	1	-	-	-	-	-	1	-	-	-	-

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OPEN ELECTIVE – II (VII SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	Course offering Department	CONTACT PERIODS	L	T	P	C
1.	1903706	Green Building Design	CIVIL	3	3	0	0	3
2.	1903716	Environmental and social impact assessment	CIVIL	3	3	0	0	3
3.	1904703	Tamil Computing	CSE	3	3	0	0	3
4.	1904010	Object Oriented Programming	CSE	3	3	0	0	3
5.	1904712	Software Engineering	CSE	3	3	0	0	3
6.	1905711	Electrical Circuits	EEE	3	3	0	0	3
7.	1905712	Renewable Energy systems	EEE	3	3	0	0	3
8.	1905713	Electric vehicles and power management	EEE	3	3	0	0	3
9.	1907001	Transducers Engineering	EIE	3	3	0	0	3
10.	1907003	Process Modeling and Simulation	EIE	3	3	0	0	3
11.	1907708	State Variable Analysis and Design	EIE	3	3	0	0	3
12.	1908003	Software Quality Management	IT	3	3	0	0	3
13.	1908004	C # and .Net Programming	IT	3	3	0	0	3
14.	1908005	Virtual Reality	IT	3	3	0	0	3
15.	1909716	Robotics	MECH	3	3	0	0	3
16.	1909717	Testing of Materials	MECH	3	3	0	0	3
17.	1909718	Design of Electric vehicles	MECH	3	3	0	0	3
18.	1910703	Clinical Trials	MEDICAL ELECTRONICS	3	3	0	0	3
19.	1910704	Regulatory requirements in pharmaceutical Industries	MEDICAL ELECTRONICS	3	3	0	0	3
20.	1910705	Microbiology	MEDICAL ELECTRONICS	3	3	0	0	3
21.	1920701	Analytical Methods and Instrumentation	PHYSICS	3	3	0	0	3
22.	1920702	Medical Physics	PHYSICS	3	3	0	0	3
23.	1920703	Electronic Materials	PHYSICS	3	3	0	0	3
24.	1921701	Waste Water Treatment	CHEMISTRY	3	3	0	0	3

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1903706 **GREEN BUILDING DESIGN** **L T P C**

3 0 0 3

OBJECTIVE:

- To develop buildings which use the natural resources to the minimal at the time of construction as well as operation.
- To ensure minimum negative impact on the environment by the construction and operation of a building.
- To gain knowledge on natural lighting and temperature control.
- To develop a design to further reduce the carbon footprint as well as reduce cost of operation.
- To preserve the external environment to the building location.

UNIT- I: ENVIRONMENTAL IMPLICATIONS OF BUILDINGS **9**

Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.

UNIT- II: IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS **9**

Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT- III: COMFORTS IN BUILDING **9**

Thermal Comfort in Buildings – Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings – Implications of Geographical Locations.

UNIT- IV: UTILITY OF SOLAR ENERGY IN BUILDINGS **9**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

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UNIT- V: GREEN COMPOSITES FOR BUILDINGS 9

Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

TOTAL: 45 PERIODS

OUTCOMES:

The students completing the course will have ability to

- Describe the concepts of sustainable design and green building techniques including energy efficiency and indoor environmental quality management.
- Create drawings and models of their own personal green building project.
- Reducing waste, pollution and environmental degradation.
- Efficiently using energy, water, and other resources.
- Protecting occupant health and improving employee productivity.

TEXT BOOKS:

1. K.S.Jagadish, B. U. Venkatarama Reddy and K. S. Nanjunda Rao. "Alternative Building Materials and Technologies". New Age International, 2007.
2. "Low Energy Cooling For Sustainable Buildings". John Wiley and Sons Ltd, 2009.
3. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.

REFERENCE BOOKS:

1. Osman Attmann, Green Architecture Advanced Technologies and Materials, McGraw Hill, 2010.
2. Jerry Yudelson, Green building Through Integrated Design, McGraw Hill, 2009.
3. Fundamentals of Integrated Design for Sustainable Building by Marian keeler, Bill Burke.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	-	3	-	-	-	-	-	2	-	-	-
CO2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	2	1	2	-	-	1	2	2	-	-	-	-	1	-
CO4	-	-	-	-	-	3	-	-	-	-	-	2	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	-	2	3	-	3	-	-

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1903716 ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT L T P C

3 0 0 3

COURSE OBJECTIVE:

- To impart the knowledge of screening of environmental and social assessment.
- To gain the knowledge of methods for impact assessment.
- To mitigate the environmental and social impacts of developmental projects.
- To develop knowledge on Assessment of Impact on land, water, air, noise and energy, flora and fauna.
- To study on report preparation of EIA.

UNIT- I: INTRODUCTION 9

Impacts of Development on Environment – Rio Principles of Sustainable Development Environmental Impact Assessment (EIA) – Objectives – Historical development – EIA Types – EIA in project cycle –EIA Notification and Legal Framework–Stakeholders and their Role in EIA– Selection & Registration Criteria for EIA Consultants.

UNIT-II: ENVIRONMENTAL ASSESSMENT 9

Screening and Scoping in EIA – Drafting of Terms of Reference, Baseline monitoring, Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna - Matrices – Networks – Checklist Methods - Mathematical models for Impact prediction – Analysis of alternatives.

UNIT- III: ENVIRONMENTAL MANAGEMENT PLAN 9

Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna – Environmental Monitoring Plan – EIA Report Preparation – Review of EIA Reports – Addressing the issues related to the Project Affected People -Environmental Clearance Post Project Monitoring.

UNIT- IV: SOCIO ECONOMIC ASSESSMENT 9

Baseline monitoring of Socio economic environment – Identification of Project Affected Personal – Rehabilitation and Resettlement Plan- Economic valuation of Environmental impacts – Cost benefit Analysis.

UNIT- V: CASE STUDIES 9

EIA case studies pertaining to Infrastructure Projects – Real Estate Development - Roads and Bridges – Multi-storey Buildings Mass Rapid Transport Systems - Ports and Harbor – Airports - Dams and Irrigation projects - Power plants – Water supply and drainage projects- Waste water treatment plants, STP – Mining Projects.

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

The students completing the course will have ability to

- Carry out scoping and screening of developmental projects for environmental and social assessments.
- To explain different methodologies for environmental impact prediction and assessment.
- Plan environmental impact assessments and environmental management plans.
- Evaluate environmental impact assessment reports.
- Analyse case studies on various projects.

TEXTBOOKS:

1. Canter, R.L, "Environmental impact Assessment", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
2. Lohani, B., J.W. Evans, H. Ludwig, R.R. Everitt, Richard A. Carpenter, and S.L. Tu, "Environmental Impact Assessment for Developing Countries in Asia", Volume 1 – Overview, Asian Development Bank,1997.
3. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers, 2009.

REFERENCE BOOKS:

1. Becker H. A., Frank Vanclay ,"The International handbook of social impact assessment" conceptual and methodological advances, Edward Elgar Publishing, 2003.
2. Barry Sadler and Mary McCabe, "Environmental Impact Assessment Training Resource Manual", United Nations Environment Programme, 2002.
3. Judith Petts, "Handbook of Environmental Impact Assessment Vol. I and II", Blackwell Science New York, 1998.
4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	1	-	2	-	-	-	-	-	2	-	-	-
CO2	-	2	-	-	-	-	1	-	-	-	-	-	-	-	3	-
CO3	-	-	-	-	2	3	2	1	2	1	-	-	-	-	-	2
CO4	-	-	2	2	-	-	1	-	-	-	-	2	-	2	-	-
CO5	-	-	-	-	-	-	1	-	-	-	2	3	-	-	-	3

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1904703 **TAMIL COMPUTING** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the Tamil grammar and programming basics for Tamil computing.
- To understand the various types of Tamil Computing applications.
- To make the students understand the use of Tamil computing tools and Resources.
- To strengthen the students' ability to carry out the Computational Linguistics in Tamil computing.
- To understand the concepts of Tamil text processing using open – Tamil python library.

UNIT - I: TAMIL GRAMMAR 9

Alphabets: Classification & Properties - Words: classification and components - Sentences: Structures and word ordering.

UNIT - II: PROGRAMMING BASICS FOR TAMIL COMPUTING 9

History of Tamil Computing - Standards & Fonts - UNICODE - Object Oriented Tamil Computing - Tamil text processing using open-tamil python library.

UNIT - III: COMPUTATIONAL LINGUISTICS 9

Basic linguistics - Phonology – Phonology computing – Tholkappiar's Morphological pattern– lexicography – syntax – semantics – pragmatics, Languages for specific purpose & disconise computing

UNIT - IV: TAMIL COMPUTING TOOLS & RESOURCES 9

POS Tagger - Morphological Analyser - Morphological Generator - Sentence Parser - Named Entity Recognizer - Word Sense Disambiguator - Ontologies – Universal Networking Language & UNL Enconvertor.

UNIT - V: TAMIL COMPUTING APPLICATIONS 9

Machine Translation – Speech : Synthesis & Processing - Information : retrieval & Extraction – Question Answering – Text Summarization – Automatic Indexing – Text Mining – Conceptual Search.

TOTAL: 45 PERIODS

OUTCOMES:

- Explain classification of Tamil grammar and properties
- Adopt a suitable process for tamil computing tools.
- Analyze the different types of computational linguistics such as phonology, Morphology, lexicography.

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- Perform and analyze the Tamil computing applications.
- Analyze and process the Tamil python library.

TEXT BOOKS:

1. The Oxford Handbook of Computational Linguistics, Edited by RuslanMitkov, Oxford University Press, 2014.
2. The Handbook of computational Linguistics and Natural Language Processing,Edited by Alexander clark, Chris Fox,shalom lappin, 2010.
3. Natural language processing and computational linguistics, Bhargav Srinivasa-Desikan Packt Publishing, first edition 2018.

REFERENCES:

1. Translation - Theory and Application, Valarmathi, International Institute of Tamil Studies, First Edition, 2001.
2. Tholkaappiyam - Thodariyal, Shanmugam, International Institute of Tamil Studies, First Edition, 2004.
3. Tholkaappiyam: Phonology & Morphology, Albert, International Institute of Tamil Studies, First Edition, 1985.
4. The Phonology and morphology of tamil chrisdas Prathima, 2016.
5. Pos Tasser R Morphological Analzser Shodhganga inflibnet.ac.in
6. A tamil Programming language ayxiv.org, muthiah Annamalai.
7. http://www.kaniyam.com/foundation/
8.http://www.tamilvu.org/

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	-	-	-		3	-	-	-	2	-	-	-	-	-	2
CO 2	-	-	-	-	3	3	-	-	-	3	-	-	-	3	-	-
CO 3	-	3	2	-	-	3	-	-	2	2	-	-	-	-	3	-
CO 4	3	2	-	-	-	3	-	-	-	2	-	-	-	2	-	-
CO 5	2	-	-	-	3	3	-	-	-	2	-	-	-	-	3	2

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1904010 OBJECT ORIENTED PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I INTRODUCTION TO OOP AND JAVA FUNDAMENTALS 9

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

UNIT II INHERITANCE AND INTERFACES 9

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

UNIT III EXCEPTION HANDLING AND I/O 9

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

UNIT IV MULTITHREADING 9

Differences between multi-threading and multitasking, thread life cycle, creating threads, synchronizing threads, Inter-thread communication, daemon threads, thread groups.

UNIT V EVENT DRIVEN PROGRAMMING 9

Graphics programming - Frame – Components - working with 2D shapes - Using color, fonts, and images - Basics of event handling - event handlers - adapter classes - actions - mouse events - AWT event hierarchy.

TOTAL: 45 PERIODS

OUTCOMES:

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

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

TEXT BOOKS:

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

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REFERENCE BOOKS:

1. Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers, 3rd Edition, Pearson, 2015.
2. Steven Holzner, ―Java 2 Black book‖, Dreamtech press, 2011.
3. Timothy Budd, ―Understanding Object-oriented programming with Java‖, Updated Edition, Pearson Education, 2000.
4. Joshua Bloch – Effective Java- 3rd Edition, Addison Wesley.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1		3	4
CO 1	3	-	-	-	-	-	2	1	-	-	1	2	-	2	-	-
CO 2	-	3	3	2	-	1	-	-	-	-	-	-	3		-	-
CO 3	2	-	-	-	-	2	-	-	2	-	-	-	-	-	2	-
CO 4	-	-	2	1	-	-	-	-	2	2	-	-	-	2	-	-
CO 5	1	-	3	1	3	2	-	-	3	3	-	-	2	-	-	-

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1904712 SOFTWARE ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

- To understand the phases in a software development project
- To understand the concepts of requirements analysis and modeling.
- To understand software design methodologies
- To learn various testing methodologies
- To be familiar with issues related to software maintenance

UNIT I SOFTWARE PROCESS 9
Introduction to Software Engineering, scope – software crisis – principles of software engineering- Software process – Life cycle models – Traditional and Agile Models - Team organization.

UNIT II PLANNING AND ESTIMATION 9
Planning and the software process – cost estimation: LOC, FP Based Estimation, COCOMO I & II Models – Duration estimation and tracking – Gantt chart - Software Project Management – plan – risk analysis and management.

UNIT III REQUIREMENTS ANALYSIS AND SPECIFICATION 9
Software Requirements: Functional and Non-Functional, Software Requirements specification– Structured system Analysis – modeling: UML based tools, DFD - Requirement Engineering Process.

UNIT IV SOFTWARE DESIGN AND IMPLEMENTATION 9
Design process – Design principles and guidelines – design techniques – coupling and cohesion - metrics – tools. Implementation: choice of programming language, programming practices – coding standards – code walkthroughs and inspections.

UNIT V TESTING AND MAINTENANCE 9
Software testing fundamentals- Testing techniques: white box, black box, glass box testing - unit testing – integration testing –system testing – acceptance testing – debugging. Post-delivery maintenance: Types – objectives - metrics - Reverse Engineering.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course, the students will be able to understand different software life cycle models.
- Perform software requirements analysis
- Apply systematic methodologies for software design and deployment.
- Understand various testing approaches and maintenance related issues.
- Plan project schedule, and estimate project cost and effort required.

TEXT BOOKS:

1. Roger S. Pressman, “Software Engineering – A Practitioner“ s Approach”, Seventh Edition, Mc Graw-Hill International Edition, 2010.
2. Ian Sommerville, “Software Engineering”, 9th Edition, Pearson Education Asia, 2011.

REFERENCE BOOKS:

1. Rajib Mall, "Fundamentals of Software Engineering", Third Edition, PHI Learning PrivateLimited, 2009.
2. Pankaj Jalote, "Software Engineering, A Precise Approach", Wiley India, 2010.
3. Kelkar S.A., "Software Engineering", Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, "Software Engineering", Tata McGraw-Hill Publishing CompanyLimited,2007.
5. http://nptel.ac.in/.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	3	3	-	-	-	-	-	-	-	2	2	-	-	-
CO 2	2	-	3	3	-	2	-	-	-	-	-	-	-	2	-	-
CO 3	-	-	3	3	-	-	-	-	-	-	3	-	-	-	2	-
CO 4	-	2	-	-	-	-	-	-	-	2	-	-	-	2	-	-
CO 5	-	2	-	-	-	3	-	-	-	-	3	-	-	-	1	-

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1905711	ELECTRICAL CIRCUITS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT-I: BASIC CIRCUITS ANALYSIS 9

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

UNIT-II: NETWORK REDUCTION AND THEOREMS FOR DC CIRCUITS 9

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

UNIT-III: AC CIRCUITS 9

Introduction to AC circuits, inductance reactance, capacitive reactance, Phasor diagrams, real power, reactive power, apparent power, power factor, R-L R-C , RLC networks, Network reduction: voltage and current division, source transformation –mesh and node analysis, Theremins' and Norton Theorems – Superposition Theorem – Maximum power transfer theorem –Reciprocity Theorem – Millman's theorem.

UNIT-IV: THREE PHASE CIRCUITS 9

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

UNIT-V: RESONANCE AND COUPLED CIRCUITS 9

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

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COURSE OUTCOMES:

- Ability to introduce electric circuits and its analysis
- Ability to impart knowledge on solving circuit equations using network theorems.
- Ability to introduce the phenomenon of resonance in coupled circuits.
- Ability to introduce Phasor diagrams of three phase circuits
- Ability to analysis of three phase circuits

TEXTBOOKS:

1.William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, edition, New Delhi, 2013.

2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2013.

3. Allan H. Robbins, Wilhelm C. Miller, "Circuit Analysis Theory and Practice", Cengage Learning India, 2013.

REFERENCE BOOKS:

1. Chakrabarti A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.

2. Jegatheesan, R., "Analysis of Electric Circuits," McGraw Hill, 2015.

3. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum‟s series, McGraw-Hill, New Delhi, 2010.

4. M E Van Valkenburg, "Network Analysis",Prentice-Hall of India Pvt Ltd, New Delhi, 2015.

5. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley & Sons, Inc. 2015

6. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", McGraw Hill, 2015.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	3	2	2	-	-	1	1	-	-	-	2	-	2	-	-
CO2	1	3	2	1	-	-	-	1	-	-	-	1	2	-	-	-
CO3	1	-	-	2	1	1	-	-	2	-	-	2	-	1	-	3
CO4	1	-	-	-	2	2	1	2	-	-	1	1	-	-	1	-
CO5	1	3	2	1	-	1	2	1	-	-	1	1	3	-	-	-

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1905712 **RENEWABLE ENERGY SYSTEMS**

L	T	P	C
3	0	0	3

OBJECTIVES:

- About the stand alone and grid connected renewable energy systems. .
- Design of power converters for renewable energy applications.
- Wind electrical generators.
- Solar energy systems.
- Power converters used for renewable energy systems.

UNIT-I: INTRODUCTION 9

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT-II: ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9

Reference theory fundamentals-principle of operation and analysis: IG and PMSG.

UNIT-III: POWER CONVERTERS 9

Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers

UNIT-IV: ANALYSIS OF WIND AND PV SYSTEMS 9

Stand alone operation of fixed and variability speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG, SCIG Based WECS, grid Integrated solar system.

UNIT-V: HYBRID RENEWABLE ENERGY SYSTEMS 9

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT).

COURSE OUTCOMES:

- Ability to handle the engineering aspects of electrical energy generation and utilization.
- Ability to understand the stand alone and grid connected renewable energy systems.

- Ability to design of power converters for renewable energy applications.
- Ability to acquire knowledge on wind electrical generators and solar energy systems.

EXTBOOKS:

1. S. N. Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, Oxford University Press, 2005.

2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company New Delhi, 2009.

REFERENCE BOOKS:

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.

2. Ion Boldea, “Variability speed generators”, Taylor & Francis group, 2006.

3. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.

4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.

5. Andrzej M. Trzynnadlowski, „Introduction to Modern Power Electronics‟, Second edition, wiley India Pvt. Ltd, 2012.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	1	2	2	1	-	-	1	-	-	-	-	3	-	-
CO2	3	2	2	1	-	1	-	-	2	-	3	1	1	2	-	-
CO3	3	2	1	2	2	2	1	-	1	-	-	-	-	1	-	1
CO4	3	3	3	2	2	1	-	-	2	-	2	1	-	-	2	-
CO5	3	2	1	1	1	2	2	-	1	-	-	2	3	-	-	-

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1905713	ELECTRIC VEHICLES AND POWER MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

To impart knowledge on the following Topics

- To understand the concept of electrical vehicles and its operations.
- To provide knowledge about Power train components.
- To understand the various Control strategies in AC and DC drives.
- To understand the need for energy storage in hybrid vehicles.
- To provide knowledge about alternative energy storage technologies that can be used in electric vehicles.

UNIT-I: ELECTRIC VEHICLES AND VEHICLE MECHANICS 9

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparisons of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics – EV Testing.

UNIT-II: ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS 9

Architecture of EV's and HEV's – Plug-n Hybrid Electric Vehicles (PHEV) - Standards - Power train components and sizing, Gears, Clutches, Transmission and Brakes.

UNIT-III: CONTROL OF DC AND AC DRIVES 9

DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor-based vector control operation – Switched reluctance motor (SRM) drives.

UNIT-IV: BATTERY ENERGY STORAGE SYSTEM 9

Battery Basics, Different types, Battery Parameters, Battery modeling, Traction Batteries, Energy management system in Electric vehicle – Battery Management Systems.

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UNIT-V: ALTERNATIVE ENERGY STORAGE SYSTEMS 9

Fuel cell – Characteristics- Types – hydrogen Storage Systems and Fuel cell EV – Ultra Capacitors

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- Learners will understand the operation of Electric vehicles and Hybrid Electric vehicles.
- Learners will gain knowledge on Power train components.
- Learners can analyze the control strategies in AC and DC drives.
- Learners will gain knowledge on various energy storage technologies for electrical vehicles.
- Learners know about alternative energy storage technologies for electric vehicles.

TEXTBOOKS:

1. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Second Edition (2011).
2. Ali Emadi, Mehrdad Ehsani, John M.Miller, "Vehicular Electric Power Systems" , Special Indian Edition, Marcel dekker, Inc 2010.
3. James Larminie and John Loury, "Electric Vehicle Technology – Explained", John Wiley & Sons Ltd, 2003.

REFERENCE BOOKS:

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel cell Vehicles" CRC Press, Taylor & Francis Group, Second Edition (2010).
2. Emanuele Crisostomi, Robert Shorten, SonjaStudli & Fabian Wirth "Electric and Plug-in Hybrid Vehicle Networks" Taylor & Francis group 2018.
3. Ronald K Jurgen, "Electric and Hybrid – Electric Vehicles", SAE, 2002.

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Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	-	1	-	2	2	2	-	-	-	1	2	-	1	-	-
CO2	2	-	2	-	1	-	1	-	2	-	2	-	2	2	-	-
CO3	3	2	1	-	2	-	-	-	2	-	-	-	-	3	-	1
CO4	3	2	2	-	1	-	2	-	-	-	2	-	-	-	2	-
CO5	3	2	1	-	1	-	-	-	1	-	2	2	2	-	-	-

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1907001 TRANSDUCERS ENGINEERING **L T P C**

3 0 0 3

COURSE OBJECTIVES:

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

UNIT - I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

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

UNIT - II CHARACTERISTICS OF TRANSDUCERS 9

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

UNIT - III VARIABLE RESISTANCE TRANSDUCERS 9

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

UNIT - IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Inductive transducers: – Principle of operation, construction details, characteristics and applications of LVDT, Induction potentiometer – Variable reluctance transducers – EI pickup-– Principle of operation, construction details, characteristics of capacitive transducers - Capacitor microphone, Proximity sensor.

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UNIT - V OTHER TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor – Digital transducers – Smart transducers - Fiber optic sensors – Thick & Thin Film sensors (Bio sensor & Chemical Sensor) – Nano sensors

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- Apply the mathematical knowledge and science & engineering fundamentals gained to solve problems pertaining to measurement applications.
- Analyze the problems related to sensors & transducers.
- Select the right sensor/transducer for a given application.
- Determine the static and dynamic characteristics of transducers
- Understand fiber optic sensor, smart transducers and their applications.

TEXT BOOKS:

1. Doebelin E.O. and Manik D.N., “Measurement Systems”, 7th Edition, McGraw-Hill Education Pvt. Ltd., 2019.
2. A. K. Sawhney, “A Course in Electrical & Electronic Measurements & Instrumentation”, Dhanpat Rai and Co, New Delhi, 2015.

REFERENCE BOOKS:

1. Bela G.Liptak, “Instrument Engineers' Handbook, Process Measurement and Analysis”, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
2. D. Patranabis, “Sensors and Transducers”, 2nd edition, Prentice Hall of India, 2010.
3. E.A. John P. Bentley, “Principles of Measurement Systems”, 4^{th} Edition, Pearson Education,2004.
4. W.Bolton, “Engineering Science”, Elsevier Newnes, Fifth edition, 2006.
5. Murthy, D.V.S., “Transducers and Instrumentation”, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
6. S.Ranganathan, “Transducer Engineering”, Allied Publishers Pvt. Ltd., 2003.

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Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	1	-	2	3	-	-	-	-	-	1	-	-	-	-
CO4	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	1	1	1	-	-	-	-	-	1	-	-	-	-

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1907003 PROCESS MODELING AND SIMULATION L T P C

3 0 0 3

COURSE OBJECTIVES:

- To give an overview of various methods of process modeling, different computational techniques for simulation.
- To analyze the simulation for steady state lumped system.
- To analyze the simulation for unsteady state lumped system.
- To analyze the simulation for steady state distributed system.
- To analyze the simulation for unsteady state distributed system.

UNIT - I INTRODUCTION 9

Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.

UNIT - II STEADY STATE LUMPED SYSTEMS 9

Degree of freedom analysis, single and network of process units, systems yielding linear and nonlinear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.

UNIT - III UNSTEADY STATE LUMPED SYSTEMS 9

Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash anddistillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.

UNIT - IV STEADY STATE DISTRIBUTED SYSTEM 9

Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.

UNIT - V UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELLING APPROACHES 9

Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Develop the process models based on Conservation principles and Process data.
- Understand the characteristics of state lumped systems.
- Understand the characteristics of state distributed lumped systems.
- Carry out the analysis and design empirical modeling of systems.
- Apply computational techniques to solve the process models.

TEXT BOOKS:

1. Ramirez, W.; "Computational Methods in Process Simulation ", 2nd Edn, Butterworths Publishers, New York, 2000.
2. Luyben, W.L., " Process Modelling Simulation and Control", 2nd Edn, McGraw-Hill Book Co.,1990.

REFERENCE BOOKS:

1. Felder, R. M. and Rousseau, R. W., "Elementary Principles of Chemical Processes", John Wiley, 2000.
2. Franks, R. G. E., "Mathematical Modelling in Chemical Engineering", John Wiley, 1967.
3. Amiya K. Jana, "Process Simulation and Control Using ASPEN", Second Edition, PHI Learning Ltd, 2012.
4. Amiya K. Jana, "Chemica lProcess Modelling and Computer Simulation" Second Edition, PHI Learning Ltd, 2012.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	3	2	-	-	-	-	-	-	1	-	-	-	-
CO2	3	3	2	3	2	-	-	-	-	-	-	1	-	-	-	-
CO3	3	3	2	3	3	-	-	-	-	-	-	1	-	-	-	-
CO4	3	3	2	3	3	-	-	-	-	-	-	1	-	-	-	-
CO5	3	3	2	3	3	-	-	-	-	-	-	1	-	-	-	-

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1907708 STATE VARIABLE ANALYSIS AND DESIGN L T P C

3 0 0 3

COURSE OBJECTIVES:

- To provide knowledge on design in state variable form.
- To study the design of state variable.
- To study the design of state estimator.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter.

UNIT - I STATE FORMULATION 9

Formulation of state variable model, non-uniqueness, controllability, observability, stability.

UNIT - II STATE VARIABLE DESIGN 9

Modes, controllability of modes -effect of state and output Feedback- pole placement Design

UNIT - III STATE ESTIMATION 9

Need for state estimation - design of state Observers - full and reduced order - disturbance estimation - separation principle

UNIT - IV OPTIMAL CONTROL 9

Introduction - Time varying optimal control - LQR steady state optimal control - Solution of Ricatti's equation - Application examples.

UNIT - V OPTIMAL ESTIMATION 9

Optimal estimation - Kalman Bucy Filter-Solution by duality principle - Discrete systems - Kalman Filter - Application examples.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

- Apply advanced control theory to practical engineering problems.
- Understand and analyse state variable design.
- Understand and analyse state estimation.
- Understand and analyse optimal controller.
- Understand and analyse optimal estimator.

TEXT BOOKS:

1. K. P. Mohandas, “Modern Control Engineering”, 2nd Edition, Sanguine Technical Publishers, 2016.
2. G. J. Thaler, “Automatic Control Systems”, Jaico Publishing House, 1993.
3. M.Gopal, “Modern Control System Theory”, 3rd Edition, New Age International Publishers, 2014.

REFERENCE BOOKS:

1. William S Levine, “Control System Fundamentals,” The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
2. Ashish Tewari, “Modern Control Design with Matlab and Simulink”, John Wiley, New Delhi, 2002.
3. K. Ogata, “Modern Control Engineering”, 5th Edition, PHI, New Delhi, 2002.
4. T. Glad and L. Ljung,, “Control Theory –Multivariable and Non-Linear Methods”, Taylor & Francis, 2002.
5. D.S.Naidu, “Optimal Control Systems”, First Indian Reprint, CRC Press, 2009.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-

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1908003 **SOFTWARE QUALITY MANAGEMENT** **L T P C**

3 0 0 3

OBJECTIVES:

- To have an introduction to software quality
- To understand software quality assurance.
- To understand about quality control and reliability.
- To understand quality management system.
- To understand about Quality Standards.

UNIT - I: INTRODUCTION TO SOFTWARE QUALITY 9

Software Quality – Hierarchical models of Boehm and McCall – Quality measurement – Metrics measurement and analysis – Gilb's approach – GQM Model

UNIT - II: SOFTWARE QUALITY ASSURANCE 9

Quality tasks – SQA plan – Teams – Characteristics – Implementation – Documentation – Reviews and Audits

UNIT - III: QUALITY CONTROL AND RELIABILITY 9

Tools for Quality – Ishikawa's basic tools – CASE tools – Defect prevention and removal– Reliability models – Rayleigh model – Reliability growth models for quality Assessment

UNIT - IV: QUALITY MANAGEMENT SYSTEM 9

Elements of QMS – Rayleigh model framework – Reliability Growth models for QMS – Complexity metrics and models – Customer satisfaction analysis

UNIT - V: QUALITY STANDARDS 9

Need for standards – ISO 9000 Series – ISO 9000-3 for software development – CMM and CMMI – Six Sigma concepts.

TOTAL: 45 PERIODS

OUTCOMES:

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

- To understand introduction about quality measurement.
- To understand SQA plan.
- To understand about Quality assessment.
- To understand about Customer satisfaction analysis.
- To understand Six Sigma Concepts.

TEXT BOOKS:

1. Allan C. Gillies, "Software Quality: Theory and Management", Thomson Learning, 2003.
2. Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Pearson Education (Singapore) Pte Ltd., 2002.

REFERENCE BOOKS:

1. Norman E. Fenton and Shari Lawrence Pfleeger, “Software Metrics” Thomson, 2003
2. Mordechai Ben – Menachem and Garry S.Marliss, “Software Quality”, Thomson Asia Pte Ltd, 2003.
3. Mary Beth Chrissis, Mike Konrad and Sandy Shrum, “CMMI”, Pearson Education (Singapore) Pte Ltd, 2003.
4. ISO 9000-3 “Notes for the application of the ISO 9001 Standard to software development”.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	3	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO 4	-	-	-	2	-	-	-	-	-	-	-	-	-	2	-	-
CO 5	3	2	3	2	-	-	-	-	-	-	-	-	-	-	3	-

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1908004	C# and .NET PROGRAMMING	L T P C
		3 0 0 3

OBJECTIVES:

- To learn basic programming in C# and the object oriented programming concepts.
- To update and enhance skills in writing Windows applications, ADO.NET and ASP .NET.
- To study the advanced concepts in data connectivity, WPF, WCF and WWF with C# and .NET 4.5.
- To implement mobile applications using .Net compact framework
- To understand the working of base class libraries, their operations and manipulation of data using XML.

UNIT - I: C# LANGUAGE BASICS 9

.Net Architecture – Core C# – Variables – Data Types – Flow control – Objects and Types- Classes and Struts – Inheritance- Generics – Arrays and Tuples – Operators and Casts – Indexers

UNIT - II: C# ADVANCED FEATURES 9

Delegates – Lambdas – Lambda Expressions – Events – Event Publisher – Event Listener – Strings and Regular Expressions – Generics – Collections – Memory Management and Pointers – Errors and Exceptions – Reflection.

UNIT - III: BASE CLASS LIBRARIES AND DATA MANIPULATION 9

Diagnostics -Tasks, Threads and Synchronization – .Net Security – Localization – Manipulating XML- SAX and DOM – Manipulating files and the Registry- Transactions – ADO.NET- Peer-to-Peer Networking – PNRP – Building P2P Applications – Windows Presentation Foundation (WPF).

UNIT - IV: WINDOW BASED APPLICATIONS, WCF AND WWF 9

Window based applications – Core ASP.NET- ASP.NET Web forms -Windows Communication Foundation (WCF)- Introduction to Web Services – .Net Remoting – Windows Service – Windows Workflow Foundation (WWF) – Activities – Workflows

UNIT - V: .NET FRAMEWORK AND COMPACT FRAMEWORK 9

Assemblies – Shared assemblies – Custom Hosting with CLR Objects – App domains – Core XAML – Bubbling and Tunneling Events- Reading and Writing XAML – .Net Compact

Framework – Compact Edition Data Stores – Errors, Testing and Debugging – Optimizing performance – Packaging and Deployment – Networking and Mobile Devices

TOTAL: 45 PERIODS

OUTCOMES:

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

- Write various applications using C# Language in the .NET Framework.
- Develop programs using advanced C# concepts on .NET
- Analyse the base class libraries, operations and manipulation of data using XML.
- Develop distributed applications using .NET Framework.
- Create mobile applications using .NET compact Framework.

TEXT BOOKS:

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner . —Professional C# 2012 and .NET 4.5, Wiley, 2012
2. Harsh Bhasin, —Programming in C#, Oxford University Press, 2014.

REFERENCE BOOKS:

1. Ian Gariffiths, Mathew Adams, Jesse Liberty, —Programming C# 4.0, OReilly, Fourth Edition, 2010.
2. Andrew Troelsen, Pro C# 5.0 and the .NET 4.5 Framework, Apress publication, 2012.
3. Andy Wigley, Daniel Moth, Peter Foot, —Mobile Development Handbook, Microsoft Press, 2011.

Course Outcomes	Program Outcomes												Program S ecific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	-	2	-	-	-	-	-	-	-	-	3	-	-	-
CO 3	2	-	3	-	-	-	-	-	-	-	-	-	3	-	2	-
CO 4	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	3	3	2	-	-	-	-	-	-	-	-	3	2	-	-

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1908005 **VIRTUAL REALITY** **L T P C**

3 0 0 3

OBJECTIVES:

- To study about basic concepts of Virtual reality
- To understand Virtual environment
- To understand geometric modeling
- To study about Virtual Hardware and Software
- To develop Virtual Reality applications

UNIT - I: INTRODUCTION TO VIRTUAL REALITY 9

Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics–Flight Simulation –Virtual environments–requirement – benefits of virtual reality- Historical development of VR : Introduction – Scientific Landmark -3D Computer Graphics :Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modeling- illumination models – Reflection models – Shading algorithms- Radiosity – Hidden Surface Removal – Realism-Stereographic image.

UNIT - II: GEOMETRIC MODELLING 9

Geometric Modeling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances –Picking – Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction – The virtual environment – the Computer environment – VR Technology – Model of interaction-VR Systems.

UNIT - III: VIRTUAL ENVIRONMENT 9

Animating the Virtual Environment: Introduction – The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and non- linear translation - shape & object in between ing – free from deformation – particle system- Physical Simulation : Introduction – Objects falling in a gravitational field-Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft.

UNIT - IV: VR HARDWARES & SOFTWARES 9

Human factors: Introduction – the eye-the ear-the somatic senses-VR Hardware : Introduction – sensor hardware – Head-coupled displays –Acoustic hardware – Integrated VR systems-VR Software: Introduction –Modeling virtual world –Physical simulation- VR toolkits – Introduction to VRML.

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UNIT - V: VR APPLICATION 9

Virtual Reality Applications: Introduction – Engineering – Entertainment – Science Training – The Future: Introduction – Virtual environments – modes of interaction.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understood the basic concept of virtual reality
- Understood 3D computer Graphics System
- Design object objects using geometric modeling
- Develop Virtual environment.
- Apply study about Virtual Hardwares, Softwares and Develop Virtual Reality applications

TEXT BOOKS:

1. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2007.
2. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 2000.

REFERENCE BOOKS:

1. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 2000.
2. Grigore C. Burdea, Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, 2nd Edition, 2006.
3. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application, and Design", Morgan Kaufmann, 2008.
4. www.vresources.org.
5. www.vrac.iastate.edu.
6. www.w3.org/MarkUp/VRM.

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Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	2	2	-	2	-	-	-	-	-	-	-	-	3	-	-
CO 5	-	-	-	-	2	-	-	-	-	-	-	-	-	3	-	-

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1909718 **ROBOTICS**

L	T	P	C
3	0	0	3

OBJECTIVES:

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

- Understand the functions of robots and review the need and application of robots in different engineering fields.
- Exemplify the different types of robot drive systems as well as robot end effectors.
- Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
- Develop robotic programs for different tasks and analyze the kinematics motions of robot.
- Implement robots in various industrial sectors and interpolate the economic analysis of robots.

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 DRIVE SYSTEMS AND END EFFECTORS 9

Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, 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

UNIT-III: SENSORS AND MACHINE VISION 9

Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors ,binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, 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.

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UNIT-IV: ROBOT KINEMATICS AND ROBOT PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces-Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design-Derivations and problems. Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT-V: IMPLEMENTATION AND ROBOT ECONOMICS 9

RGV, AGV; Implementation of Robots in Industries -Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL : 45 PERIODS

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

- Understand the functions of robots and review the need and application of robots in different engineering fields.
- Exemplify the different types of robot drive systems as well as robot end effectors.
- Apply the different sensors and image processing techniques in robotics to improve the ability of robots.
- Develop robotic programs for different tasks and analyze the kinematics motions of robot.
- Implement robots in various industrial sectors and interpolate the economic analysis of robots.

TEXTBOOKS:

1. Klafter R.D., Chmielewski T.A and Negin M., “Robotic Engineering - An Integrated Approach”, Prentice Hall, 2003.
2. Groover M.P., “Industrial Robotics -Technology Programming and Applications”, McGraw Hill, 2001.

REFERENCE BOOKS:

1. Craig J.J., “Introduction to Robotics Mechanics and Control”, Pearson Education, 2008.
2. Deb S.R., “Robotics Technology and Flexible Automation” Tata McGraw Hill Book Co., 1994.
3. Koren Y., “Robotics for Engineers", McGraw Hill Book Co., 1992.
4. Fu.K.S.,Gonzalz R.C. and Lee C.S.G., “Robotics Control, Sensing, Vision and Intelligence”,McGraw Hill Book Co., 1987.
5. Rajput R.K., “Robotics and Industrial Automation”, S.Chand and Company, 2008.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	1	2	-	-	-	-	-	-	-	-	2	2	-	-
CO2	3	-	2	2	-	-	-	-	-	-	-	1	2	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	1	2	2	-	-
CO4	3	-	2	3	-	-	-	-	-	-	-	1	2	2	-	-
CO5	3	-	3	3	-	-	-	-	-	-	-	1	1	2	-	-

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1909719	TESTING OF MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

- Apply the concept of testing to various materials and result analysis.
- Apply various mechanical testing procedures to different materials.
- Apply different nondestructive testing procedures to different materials.
- Apply material characterization testing for analysis.
- Apply advanced testing techniques for thermal and chemical fields.

UNIT-I: INTRODUCTION TO MATERIALS TESTING 9

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing

UNIT-II: MECHANICAL TESTING 9

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT-III: NON DESTRUCTIVE TESTING 9

Visual inspection, Liquid penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT-IV: MATERIAL CHARACTERIZATION TESTING 9

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT-V: OTHER TESTING

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL : 45 PERIODS

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

- Apply the concept of testing to various materials and result analysis.
- Apply various mechanical testing procedures to different materials.
- Apply different nondestructive testing procedures to different materials.
- Apply material characterization testing for analysis.
- Apply advanced testing techniques for thermal and chemical fields.

TEXTBOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Cullity, B. D., "Elements of X-ray diffraction", 3^{rd} Edition, Addison-Wesley Company Inc., New York, 2000.

REFERENCE BOOKS:

1. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7^{th} Edition, Cousens Press, 2007.
2. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9^{th} Edition, American Society for Metals, 1978.
3. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
4. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	1	1	-	-	-	-	-	-	-	1	1	1	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	1	1	1	-	-
CO3	2	2	1	1	-	-	-	-	-	-	-	1	1	1	-	-
CO4	3	2	1	1	-	-	-	-	-	-	-	1	1	1	-	-
CO5	3	2	1	1	-	-	-	-	-	-	-	1	1	1	-	-

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1909720 DESIGN OF ELECTRIC VEHICLES

	L	T	P	C
	3	0	0	3

OBJECTIVES:

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

- Understand about electric vehicle technology.
- Understand the load distribution and stability of vehicles.
- Analyze the handling characteristics of road vehicles.
- Analyze the steering, suspension and designing of breaks.
- Understand hybrid vehicles, power electronics and fuel cell vehicles.

UNIT-I: INTRODUCTION TO ELECTRIC VEHICLES 9

Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types. Battery plug-in and life. Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar.

UNIT-II: STABILITY OF VEHICLES 9

Load distribution for three wheeler and four wheeler-Stability of vehicle running on slope, banked road and during turn-calculation of Tractive effort, maximum acceleration and reaction forces for different drives.

UNIT-III: HANDLING CHARACTERISTICS OF ROAD VEHICLES 9

Steering geometry-Steady state handling characteristics- Steady state response to steering input-Testing of handling characteristics-Transient response characteristics- Directional stability.

UNIT-IV: STEERING, SUSPENSION AND BRAKE 9

Steering System - Ackerman Principle of Steering - Front End Geometry - Steering Gearbox- Types-Recirculating Ball - Rack and Pinion - Power Steering. Suspension - Front and Rear Forks - Springs for Suspension - Telescopic Suspension - Monoshock Suspension - Hydraulic Shock Absorber - Dampers. Design Consideration – Brake - Drum Brakes - Disc Brakes – ABS

UNIT-V: Power Electronics and Control for Hybrid and Fuel Cell Vehicles 9

Series Hybrid Vehicle Propulsion System, Parallel Hybrid Vehicle Propulsion System, Fuel Cell Vehicles, Power Electronics Requirements, Propulsion Motor Control Strategies, APU Control System in Series Hybrid Vehicles, Fuel Cell for APU Applications.

TOTAL : 45 PERIODS

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

- Understand about electric vehicle technology.
- Understand the load distribution and stability of vehicles.
- Analyze the handling characteristics of road vehicles.
- Analyze the steering, suspension and designing of breaks.
- Understand hybrid vehicles, power electronics and fuel cell vehicles.

TEXTBOOKS:

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2. Rajesh Rajamani, "Vehicle Dynamics and Control", 1st edition, Springer, 2005

REFERENCE BOOKS:

1. Thomas D. Gillespie, "Fundamentals of Vehicle Dynamics", Society of Automotive Engineers Inc, 1992.
2. Dr.Kirpal Singh, 'Automobile Engineering'- Vol. I and II, Standard Publishers, New Delhi, 2011
3. V. Ganesan, 'Internal Combustion Engines', Tata McGraw Hill Book Co, Eighth Reprint, 2010.
4. Ali Emadi, "Handbook of Automotive Power Electronics and Drives", Taylor & Francis Group, First Edition, USA, 2005.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	2	1	1	-	1	-	1	-	-	1	2	2	1	2	-
CO2	2	-	-	1	2	-	-	-	1	-	-	-	-	-	-	-
CO3	1	-	1	-	-	1	-	-	-	-	1	-	-	1	1	-
CO4	-	2	2	1	-	-	2	-	-	-	-	-	-	-	-	-
CO5	2	2	-	1	-	-	-	-	-	-	2	-	2	1	1	-

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1910703 **CLINICAL TRIALS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To highlight the epidemiologic methods, study design, protocol preparation.
- To learn about the crossover and factorial trial designs.
- To acquire knowledge in the basic bio-statistical techniques involved in clinical research.
- To describe the principle involved in ethical, legal and regulatory issues in clinical trials.
- To explore the reporting of trials.

UNIT – I: ROLE OF CLINICAL TRIALS IN NEW DRUG DEVELOPMENT 9

Drug Discovery, Regulatory guidance and governance, Pharmaceutical manufacturing, Non-clinicalresearch, Clinical trials, Post-marketing surveillance, Ethical conduct during clinical trials.

UNIT – II: FUNDAMENTALS OF TRIAL DESIGN 9

Randomised clinical trials, Uncontrolled trials. Protocol development, Endpoints, Patient selection, Source and control of bias, Randomization, Blinding, Sample size and power.

UNIT – III: ALTERNATE TRIAL DESIGNS 9

Crossover design, Factorial design, Equivalence trials, Bioequivalence trials, Non-inferiority trials, Cluster randomized trials, Multi-center trials.

UNIT – IV: BASICS OF STATISTICAL ANALYSIS 9

Types of data and normal distribution, Significance tests and confidence intervals, Comparison of means, Comparison of proportions, Analysis of survival data, Subgroup analysis, Regression analysis, Missing data.

UNIT – V: REPORTING OF TRIALS 9

Overview of reporting, Trial profile, Presenting baseline data, Use of tables, Figures, Critical appraisal of report, Meta-analysis.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Explain key concepts in the design of clinical trials.
- Describe study designs used in data management for clinical trials.
- Identify key issues and determine alternate trial designs.

- Recognize the roles of regulatory affairs in clinical trials.
- Provide the overview of reporting trials.

TEXT BOOKS:

1. Lawrence M. Friedman, “Fundamentals of Clinical Trials”, Springer Science & Business Media, Fifth Edition, 2015.
2. Stuart J. Pocock, “Clinical Trials: A Practical Approach”, John Wiley & Sons, 2013.

REFERENCE BOOKS:

1. David Machin, Simon Day, Sylvan Green, “Textbook of Clinical Trials”, Second Edition, John Wiley & Sons, 2007.
2. Duolao Wang, Ameet Bakhai, “Clinical trials, A practical guide to design, analysis and reporting”, First Edition, Remedica, 2006.
3. T.A. Durham, J Rick Turner, “Introduction to statistics in pharmaceutical clinical trials”, First Edition, Pharmaceutical Press, 2008.
4. Tom Brody, “Clinical Trials: Study Design, Endpoints and Biomarkers, Drug Safety, and FDA and ICH Guidelines”, Second Edition, Academic Press, 2016.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	-	-	2	-	-	-	2	-	-	-	-
CO2	3	2	2	-	-	-	-	2	-	-	-	2	2	3	-	-
CO3	3	3	2	2	-	-	-	2	-	-	-	2	2	3	-	-
CO4	3	3	-	-	-	-	2	3	-	-	-	2	2	2	-	-
CO5	3	-	-	-	-	-	-	3	-	-	-	2	2	2	-	-

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1910704 REGULATORY REQUIREMENTS IN PHARMACEUTICAL INDUSTRIES **L T P C 3 0 0 3**

OBJECTIVES:

The student should be made:

- To acquire knowledge in pharmaceutical industry regulations.
- To learn about the packaging and labeling of drugs.
- To understand the patent filling process.
- To analyze the quality guidelines in drug products.
- To explore the process of documentation.

UNIT - I: REGULATORY CONCEPTS **9**

Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

UNIT – II: REGULATORY ASPECTS **9**

Pharmaceuticals: Bulk drug manufacture; Personnel, Buildings and Facilities, Process Equipment, Documentation and Records, Materials Management, Production and In-Process Controls, Packaging and Identification Labelling of API‟s and Intermediates, Storage and distribution, Biotechnology derived products; Principles, Personnel, Premises and equipments, Animal quarters and care, production, labelling, Lot processing records and distribution records, Quality assurance and quality control.

UNIT – III: INTELLECTUAL PROPERTY RIGHTS **9**

Patent system – Different types of patents – Filing process of application for patent – Infringement of patents – The patent rules 2003 as amended by the patents (amendment) rules 2016.

UNIT – IV: ICH GUIDELINES **9**

Quality guidelines – Impurities in new drug substances (Q3A (R2)) – Impurities in newdrug products(Q3B(R2)) – Validation of analytical procedures text and methodology (Q2 (R1)).

UNIT – V: QUALITY AUDIT AND SELF INSPECTIONS **9**

SOPs – Documentation – Loan license auditing – Common technical documentation (CTD) – Drug master file (DMF).

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Explain the pharmaceutical industry manufacturing practices and regulatory aspects of pharmacy products.
- Describe the process of patenting activities.
- Assess the different types of patents and filling process.
- Explore the quality guidelines followed for pharmaceutical products.
- Enumerate the aspects involved in document preparation for pharmaceutical product registration.

TEXT BOOKS:

1. C. V. Subbrahmanyam & J. Thimmasetty, “Pharmaceutical regulatory affairs”, First Edition, Vallabh Prakashan, New Delhi, 2012.
2. Willig, H., Tuckerman, M.M. and Hitchings, W.S., “Good Manufacturing Practices for Pharmaceuticals”, Fifth Edition, Marcel Dekker Drugs and the Pharmaceutical Sciences, by CRC Press, New York, 2000.
3. N Udupa, Krishnamurthy Bhat, “A Concise Textbook of Drug Regulatory Affairs”, First Edition, Manipal University Press (MUP); 2015.

REFERENCE BOOKS:

1. Ira R. Berry, “The Pharmaceutical Regulatory Process, marcel dekker Series: Drugs and the Pharmaceutical Sciences”, CRC Press, Newyork, 2004.
2. Mindy J. Allport-Settle, “Current Good Manufacturing Practices: Pharmaceutical, Biologics, and Medical Device Regulations and Guidance Documents Concise Reference”, Pharmalogika Inc., USA, 2009.
3. Sharma, P.P., “How to Practice GMPs”, Third Edition, Vandana Publications, 2006.

Course Outcomes	**Program Outcomes**												**Program Specific Outcomes**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	-	-	-	-	-	3	3	-	-	-	3	2	-	-	-
CO2	2	3	-	-	-	2	3	3	-	-	-	2	2	-	-	-
CO3	2	2	3	2	-	2	3	3	-	-	-	2	2	-	-	-
CO4	2	-	-	-	-	2	3	3	-	-	-	2	2	-	-	-
CO5	2	-	-	-	-	2	3	3	-	-	-	2	2	-	-	-

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1910705 MICROBIOLOGY L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the principles of Microbiology.
- To emphasize the structure and biochemical aspects of various microbes.
- To learn about the Nutritional classification of microorganisms.
- To gain knowledge on the physical and chemical control of microorganisms.
- To acquire knowledge about the preservation of food.

UNIT – I: INTRODUCTION TO MICROBIOLOGY 9

Classification and nomenclature of microorganisms, Microscopic examination of microorganisms: Light, Fluorescent, Dark field, Phase contrast, and Electron microscopy.

UNIT – II: MICROBES- STRUCTURE AND REPRODUCTION 9

Structural organization and multiplication of bacteria, Viruses (TMV, Hepatitis B), Algae(cyanophyta, rhodophyta) and Fungi (Neurospora), Life history of actinomycetes (Streptomyces), Yeast (Sacharomyces), Mycoplasma (M. pneumoniae) and Bacteriophages (T4 phage, ʎphage)

UNIT – III: MICROBIAL NUTRITION, GROWTH AND METABOLISM 9

Nutritional classification of microorganisms based on carbon, Energy and electron sources . Definition of growth, Balanced and unbalanced growth, Growth curve and different methods to quantify bacterial growth:(counting chamber, viable count method, counting without equipment),Different media used for bacterial culture (defined, complex, selective, differential, enriched),The mathematics of growth-generation time, Specific growth rate.

UNIT – IV: CONTROL OF MICROORGANISMS 9

Physical and chemical control of microorganisms, Definition of sterilization, Dry and moist heat, Pasteurization, Tyndalization, Radiation, Ultrasonication, Filtration. Disinfections anitization, Antiseptics sterilants and fumigation. Mode of action and resistance to antibiotics, Clinically important microorganisms.

UNIT – V: INDUSTRIAL MICROBIOLOGY 9

Microbes involved in preservation (Lactobacillus, bacteriocins), Spoilage of food and food borne pathogens (E.coli, S.aureus, Bacillus, Clostridium). Industrial use of microbes

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(production of penicillin, alcohol, vitamin B-12); Biogas; Bioremediation (oil spillage leaching of ores by microorganisms, pollution control); Biofertilizers, Biopesticides. Biosensors. Quality assurance – Quality control – Practice of cGMP – Schedule M – USFDA.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Explain the fundamentals of Microbiology.
- Explore the scope of Microbiology.
- Apply knowledge to solve the problems in microbial infection and their control.
- Analyze the concept of food preservation.
- Describe the industrial use of microbes.

TEXT BOOKS:

1. Ananthanarayanan, R. and C.K. Jayaram Paniker, “Textbook of Microbiology”, University Press, Ninth Edition, 2015.
2. Prescott L.M., Harley J.P., Klein DA, “Microbiology”, Eleventh Edition, McGraw -Hill Inc., 2020.

REFERENCE BOOKS:

1. Pelczar, M.J. “Microbiology”, Fifth Edition, Tata McGraw-Hill, 1993.
2. Talaron K, Talaron A, Casita, Pelczar and Reid. Foundations in Microbiology, W.C. Brown Publishers, 1993.
3. Schlegel, H.G. “General Microbiology”, Seventh Edition, Cambridge University Press, 1993.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	-	-	-	-	-	-	2	2	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	2	2	-	-	-
CO3	3	2	2	2	-	2	1	2	-	-	-	2	2	2	2	-
CO4	3	-	-	2	-	1	2	2	-	-	-	2	2	2	-	-
CO5	3	-	-	-	-	3	2	-	-	-	-	2	2	-	-	-

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1920701 ANALYTICAL METHODS AND INSTRUMENTATION **L T P C**
3 0 0 3

OBJECTIVES:

- Make the students understand the basics of spectrometry
- To explore the knowledge on molecular spectroscopy.
- To introduce the NMR and MASS spectrometry.
- To elucidate the various separation methods in chromatography.
- To gain knowledge on potentiometry and surface microscope.

UNIT- I: SPECTROMETRY 9

Properties of electromagnetic radiation- wave properties – components of optical instruments– Sources of radiation – wavelength selectors – sample containers – radiation transducers – Signal process and read outs – signal to noise ratio - sources of noise – Enhancement of signal to noise - types of optical instruments – Applications.

UNIT –II: MOLECULAR SPECTROSCOPY 9

Molecular absorption spectrometry – Measurement of Transmittance and Absorbance – Beer's law – Instrumentation - Applications -Theory of fluorescence and Phosphorescence –Theory of Infrared absorption spectrometry – IR instrumentation – Applications – Theory of Raman spectroscopy – Instrumentation – applications.

UNIT- III: NMR AND MASS SPECTROMETRY 9

Theory of NMR – chemical shift- NMR-spectrometers – applications of 1H and 13C NMR-Molecular mass spectra – ion sources.Mass spectrometer.Applications of molecular mass - Electron paramagnetic resonance- g values – instrumentation.

UNIT- IV: SEPARATION METHODS 9

General description of chromatography – Band broadening and optimization of column performance-Liquid chromatography – Partition chromatography – Adsorption chromatography – Ion exchange chromatography -size exclusion chromatography- Affinity chromatography- principles of GC and applications – HPLC- Capillary electrophoresis – Applications.

UNIT-V: ELECTRO ANALYSIS AND SURFACE MICROSCOPY 9

Electrochemical cells- Electrode potential cell potentials – potentiometry- reference electrode – ionselective and molecular selective electrodes – Instrument for potentiometric studies – Voltametry – Cyclic and pulse voltametry- Applications of voltametry . Study of surfaces – Scanning probemicroscopes – AFM and STM.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand the concept of spectrometry
- Ability to know the operations of various instruments.
- Able to apply molecular spectroscopy concepts in NMR and MASS spectrometry.
- Ability to understand surface microscopy and its applications.

TEXT BOOKS:

1. Skoog, D.A. F. James Holler, and Stanky, R.Crouch “Instrumental Methods of Analysis”.CengageLearning , 2007.
2. Willard, Hobart, etal., “Instrumental Methods of Analysis”. VIIth Edition, CBS, 1986.
3. Braun, Robert D. “Introduction to Instrumental Analysis”. Pharma Book Syndicate, 1987.
4. Ewing,G.W. “Instrumental Methods of Chemical Analysis”, Vth Edition, McGraw-Hill, 1985

REFERENCE BOOKS:

1. Sharma, B.K. “Instrumental Methods of Chemical Analysis : Analytical Chemistry” GoelPublishing House, 1972.
2. Haven, Mary C., etal., “Laboratory Instrumentation “. IVth Edition, John Wiley, 1995.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	3	2	2	-	-	3	-	3	2	1	3	1	-	
CO2	2	2	3	2	2	-	-	2	2	3	2	1	3	1	-	-
CO3	2	2	3	3	3	-	2	2	2	3	3	1	3	1	-	-
CO4	3	2	3	3	3	-	-	3	2	3	3	1	3	1	-	-
CO5	3	-	3	2	2	-	-	3	-	3	2	1	3	1	-	-

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1920702 **MEDICAL PHYSICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the complete non-ionizing radiations including light and its effect in human body.
- To understand the principles of ultrasound radiation and its applications in medicine.
- To learn about radioactive nuclides.
- To know the interactions of radiation with matters and how isotopes are produced.
- To study the harmful effects of radiation and radiation protection regulations.

UNIT-I: NON-IONIZING RADIATION AND ITSMEDICALAPPLICATION 9

Introduction to EM waves - Tissue as a leaky dielectric - Relaxation processes: Debye model, Cole–Cole model- Overview of non-ionizing radiation effects-Low Frequency Effects- Higher frequency effects. Physics of light-Measurement of light and its unit- limits of vision and color vision an overview - Applications of ultraviolet in medicine, Thermography.

UNIT-II: ULTRASOUND IN MEDICINE 9

Ultrasound fundamentals – Generation of ultrasound (Ultrasound Transducer) - Interaction of Ultrasound with matter: Cavitation, Reflection, Transmission-Scanning systems – Artefacts- Ultrasound- Doppler-Double Doppler shift-Clinical Applications- Ultrasonography.

UNIT-III: PRINCIPLES OF RADIOACTIVE NUCLIDESANDDECAY 9

Introduction to Radioisotopes - Radioactive decay : Spontaneous Fission, Isomeric Transition, Alpha Decay, Beta Decay, Positron Decay, Electron Capture-Radioactive decay equations – Half life- Mean Life- Effective half-life - Natural and Artificial radioactivity, - Production of radionuclide – Cyclotron produced Radionuclide - Reactor produced Radionuclide: fission and electron Capture reaction, Target and Its Processing Equation for Production of Radionuclide - Radionuclide Generator-Technetium generator.

UNIT-IV: INTERACTION OF RADIATIONWITH MATTER 9

Interaction of charged particles with matter –Specific ionization, Linear energy transfer, range, Bremsstrahlung, Annihilation - Interaction of X and Gamma radiation with matter: Photoelectric effect, Compton Scattering, Pair production-Attenuation of Gamma Radiation - Interaction of neutron with matter and their clinical significance- Radionuclide used in Medicine and Technology.

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UNIT-V: RADIATION EFFECTSAND REGULATIONS 9

Classification of Radiation Damage, Stochastic and Deterministic Effects, Acute Effects of Total Body Irradiation, Long-Term Effects of Radiation, Risk Versus Benefit in Diagnostic Radiology and Nuclear Medicine, Risk of Pregnant Women, Nuclear Regulatory Commission, ALARA Program, Medical Uses of Radioactive Materials, Survey for Contamination and Exposure Rate, Dose Calibrators and Survey Meters, Bioassay, Radioactive Waste Disposal.

TOTAL: 45 PERIODS

OUTCOMES

- Analyze the low frequency and high frequency effects of non-ionizing radiation and physics of light.
- Define various clinical applications based on ultra sound wave.
- Explain the process of radioactive nuclide production using different techniques
- Analyze radiation mechanics involved with various physiological systems
- Outline the detrimental effects of radiation and regulations for radiation safety.

TEXT BOOKS:

1. B H Brown, R H Smallwood, D C Barber, P V Lawford and D R Hose, Medical Physics and Biomedical Engineering, 2nd Edition, IOP Publishers.2001. (Unit I &II)
2. Gopal B. Saha, Physics and Radiobiology of Nuclear Medicine, 4th Edition, Springer, 2013. (Unit III &IV)
3. R.Hendee and Russell Ritenour “Medical Imaging Physics”, Fourth Edition William, Wiley-Liss, 2002. (Unit V).

REFERENCE BOOKS:

1. S.Webb “ The Physics of Medical Imaging”, Taylor and Francis,1988
2. HyltonB.Meire and Pat Farrant “Basic Ultrasound” John Wiley & Sons,1995
3. John R Cameran, James G Skofronick “Medical Physics” John-Wiley & Sons.1978.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	1	-	-	2	1	-	-	-	-	3	-	2	-	-
CO2	3	1	2	2	1	-	1	-	-	-	-	3	-	2	-	-
CO3	3	1	2	-	-	2	2	-	-	-	-	2	-	2	-	-
CO4	2	1	1	-	1	1	1	-	-	-	-	1	-	2	-	-
CO5	3	2	3	-	2	1	3	-	-	-	-	3	-	2	-	-

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1920703 **ELECTRONIC MATERIALS** **L T P C**
3 0 0 3

OBJECTIVES

- To Understand the various materials and its properties towards electrical and electronics field.
- To cover the properties of conducting materials.
- Make the students to understand various semiconducting and magnetic materials and their properties.
- To give an idea on dielectric and insulating materials.
- To explore the knowledge on optoelectronic and nano materials.

UNIT- I: INTRODUCTION 7

Structure: atomic structures and bonding, types of bonding, band formation. Defects and imperfections in solids: Point, Line and Planar defects; Interfacial defects and volume defects. Classification of materials based on bonding: conductors, semiconductors and insulators.

UNIT- II: CONDUCTING MATERIALS 9

Introduction, factors affecting the conductivity of materials, classification based on conductivity of materials, temperature dependence of resistivity, Low resistivity materials (graphite, Al, Cu and steel) and its applications, high resistivity materials (manganin, constantan, nichrome, tungsten) and their applications. Superconductors: Meissner effect, classification and applications.

UNIT- III: SEMICONDUCTING AND MAGNETIC MATERIALS 10

Semiconductors: Introduction, types of semiconductors, temperature dependence of semiconductors, compound semiconductors, basic ideas of amorphous and organic semiconductors. Magnetic Materials: classification of magnetic materials, ferromagnetism-B-H curve (Qualitative), hard and soft magnetic materials, magneto materials applications.

UNIT- IV: DIELECTRIC AND INSULATING MATERIALS 9

Dielectric Materials: Introduction, classification, temperature dependence on polarization, properties,dielectric loss, factors influencing dielectric strength and capacitor materials, applications. Insulators: Introduction, thermal and mechanical properties required for insulators, Inorganic materials, organic materials, liquid insulators, gaseous insulators and ageing of insulators, applications.

UNIT –V: OPTOELECTRONIC ANDNANO ELECTRONIC MATERIALS 10

Optoelectronic materials. Introduction, properties, factor affecting optical properties, role of optoelectronic materials in LEDs, LASERs, photo detectors, solar cells. Nano electronic Materials: Introduction, advantage of nanoelectronic devices, materials, fabrication, challenges in Nano electronic materials.

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand the fundamentals of conducting materials
- Able to define various applications of semiconducting and magnetic materials
- Able to explain the concepts of dielectrics and insulating materials
- Ability to explain various optoelectronic devices and nano electronic materials
- With the basis, students will be able to have clear concepts on electronic behaviors of materials.

TEXT BOOKS:

1. S.O. Kasap “Principles of Electronic Materials and Devices”, 3rd edition, McGraw-Hill Education (India) Pvt. Ltd., 2007.
2. W D Callister, “Materials Science & Engineering – An Introduction”, Jr., John Willey &Sons,Inc, New York, 7th edition, 2007.

REFERENCE BOOKS:

1. B.G. Streetman and S. Banerjee, Solid State Electronic Devices, 6th edition, PHI Learning, 2009.
2. Eugene A. Irene, Electronic Materials Science, Wiley, 2005.
3. Wei Gao, Zhengwei Li, Nigel Sammes, An Introduction to Electronic Materials for Engineers, 2nd Edition, World Scientific Publishing Co. Pvt. Ltd., 2011.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1	2	1	1	1	1	-	-	-	1	1	1	-	-	
CO2	2	2	2	1	2	-	-	-	-	-	-	1	-	1	-	-
CO3	3	3	3	-	3	2	-	-	-	-	-	1	-	-	1	-
CO4	2	3	3	1	3	3	-	-	-	-	-	1	-	1	-	1
CO5	2	3	2	1	3	3	-	-	-	-	1	1	-	-	-	2

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1921701 **WASTE WATER TREATMENT** **L T P C**
3 0 0 3

OBJECTIVES

- To make the student conversant with the water treatment methods including adsorption and oxidation process.
- To provide basic under standings about the requirements of water and its preliminary treatment.
- To study the dynamic processes and understand the features of corrosion and its effects
- To develop and understand the waste water treatment process
- To provide a broad view about the water quality and its standards

UNIT-I: WATER QUALITY AND PRELIMINARY TREATMENT 9

Water Quality-physical-chemical and biological parameters of water-Water quality requirement - potable water standards-Wastewater effluent standards-water quality indices. Water purification systems in natural systems- physical processes-chemical processes and biological processes-Primary, secondary and tertiary treatment-Unit operations-unit processes. Mixing, clarification-sedimentation; Types-aeration and gas transfer-coagulation and flocculation, coagulation processes.

UNIT-II: INDUSTRIAL WATER TREATMENT 9

Filtration-size and shape characteristics of filtering media-sand filters hydraulics of filtration-design considerations-radial, upflow, highrate and multimedia filters, pressure filter. Water softening-lime soda, zeolite and demineralization processes – Boiler troubles-scale, sludge, priming, foaming, caustic embrittlement and boiler corrosion.

UNIT-III: CONVENTIONAL TREATMENT METHODS 9

Taste and odour control-Adsorption-activated carbon treatment-removal of color-iron and manganese removal-aeration, oxidation, ion exchange and other methods-effects of fluorides-fluoridation and defluoridation-desalination-Corrosion prevention and control-factors influencing corrosion-Langelier index-Corrosion control measures.

UNIT-IV: WASTEWATER TREATMENT 9

Wastewater treatment-pre and primary treatment-equalization neutralization-screening and grid removal-sedimentation-oil separation gas stripping of volatile organics-biological oxidation-lagoons and stabilization basins-aerated lagoons-activated sludge process-trickling filtration-anaerobic decomposition-Break point chlorination.

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UNIT-V: ADSORPTION AND OXIDATION PROCESSES 9

Chemical process-Adsorption-theory of adsorption-Ion exchange process-chemical oxidation- advanced oxidation process-sludge handling and disposal-Miscellaneous treatment processes.

Total Periods: 45

OUTCOMES

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

- Gain idea about various methods available for water treatment.
- Appreciate the necessity of water and acquire knowledge of preliminary treatment.
- Interpret the nature of corrosion and its harmful effects.
- Value the various waste water treatment methods.
- Understand about adsorption and oxidation process.

TEXTBOOKS:

1. Metcalf and Eddy, “Wastewater Engineering”, 4th ed., McGraw Hill Higher Edu., 2002.
2. G.L.Karia and R.A. Christian, Waste Water Treatment, Concepts and Design Approach, Prentice Hall, 2013.
3. Joanne E. Drinon and Frank Spellman, Water and Waste Water Treatment, CRC Press, 2012.

REFERENCE BOOKS:

1. S.P. Mahajan, “Pollution control in process industries”, 27th Ed. Tata McGraw Hill Publishing Company Ltd., 2012.
2. M. Lancaster, “Green Chemistry: An Introductory Text”, 2nd edition, RSC publishing, 2010.
3. C.S. Rao, “Environmental Pollution Control Engineering”, New Age International, 2007.
4. M.J. Hammer and M.J. Hammer (Jr.), Water and Waste Water Technology, Pearson, 2011.

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	1	-	1	-	-	-	-	-	-	1	-	-	-	-
CO2	1	2	-	-	-	-	-	-	1	-	-	1	-	-	-	-
CO3	3	1	2	-	1	-	-	1	-	-	1	2	-	-	-	-
CO4	2	1	-	-	-	1	-	-	-	-	-	1	-	-	-	-
CO5	3	2	-	-	-	1	-	-	-	-	-	1	-	-	-	-