SRM VALLIAMMAI
ENGINEERING COLLEGE

(AN AUTONOMOUS INSTITUTION)

SRM Nagar, Kattankulathur - 603 203.

**Approved by AICTE, Affiliated to Anna University,
Accredited by NBA 'A' Grade Accreditation by NAAC,
ISO 9001: 2015 Certified**

VALLIAMMAI ENGINEERING COLLEGE

SRM

CURRICULA AND SYLLABI

B.E – MEDICAL ELECTRONICS

REGULATION 2019

SRM VALLIAMMAI ENGINEERING COLLEGE

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

B.E. MEDICAL ELECTRONICS

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 Medical Electronics 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 Medical Electronics 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 in healthcare.
2. Ability to use the advanced technology for measurement and develop innovative sustained solutions in health care.
3. Ability to examine indigenous clinical gadgets through the application of their core area ideas and emerging ICTs
4. Ability to perform effectively as a part of a team with professional behavior and ethics to achieve a successful career.

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- MEDICAL ELECTRONICS

			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				
		Electrical and Electronic Measurements	3	3	2	2	2	2	2	2	2				3	3	2	2
		Analog Electronics	2	3	3	2		2						2	2			
		Digital Electronics	3	3	2	2	3	2						1	2	1	2	
		Anatomy and Human Physiology	3			2				2				2	2	2		
		Signals and Systems	3	2	1	2								1	2	2		
		Instrumentation Laboratory	3	3	2	2	2	2	2	1					3	3	2	2
		Analog and Digital Electronics Laboratory	3	2	2	2	3	2			3	3		2	3	3	3	3
		Communication Skills Laboratory-Project based.	3	3	2	2	3		3			3		1	2	1	1	2
Year II	Sem IV	Discrete-Time Signal Processing	3	2	2	2		3	3	3	2	2		1	3	2		3
		Linear Integrated Circuits	3	3	3	2								2	2	2		
		Electrical Engineering	2	3	2	2	3	1		2	1	1	2	2				
		Bio Materials and Artificial Organs	3	3	3	3		3	2	2		3		3	2	2		
		Control Systems Engineering	1	1	1	1	1	2	1	2	1	1	1	2				
		Professional Ethics						3	3	2								
		Digital Signal Processing Laboratory	3	2	2	2	2		2	2	2	3	1	2	2	2	3	2
		Linear Integrated Circuits Laboratory	3	3	3	2	3	1			2	2		2	2	2	3	

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year III	Sem V	Therapeutic Equipments	2	1	3	1		3	2	2		3		2	2	2	2	1
		Medical Instrumentation	2	3	3	3	3	3	3	2	2	2		2	2	3	3	
		Analog and Digital Communication	3	2	3	3		2	2	2				3				
		Professional Elective - I																
		Professional Elective - II																
		Open Elective –I																
		Medical Equipment Laboratory	2	2	1	2	2	1	1	1	2	1		1	2	2	2	1
		Medical Instrumentation Laboratory	2	3	3	3		3	3	2	3	2		2	3	3	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	
		Human Assist Devices	3	2	3	3	3	3	2	2				3	2	3		
		Medical Imaging Techniques	3	2		2	1	1	1	2		1		1	2	2	1	1
		Biomechanics	2	2	2	1	1	1							2	1	1	1
		Internet of Things and its Applications	2			3		3	3							2	2	
		Professional Elective-III																
		Microprocessors and Microcontrollers Laboratory	2	2	3	2	3	3	3		3	3	3	3	2	2	1	1
		Medical Electronics System Design Laboratory	1	2	3	2	3				2	2			3	1	2	2
		Mini Project	1	2	3	3	2	1	1	1	3	2	1	1	2	2	2	1

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
IV	Sem VII	Digital Image Processing	3	2	2	2								2	2	2		
		Physiological Modelling	3	3	3	3	3	2	2	2		3		2	2	2	3	
		Body Area Networks	3	3	2	2		2	2	2				2	2	2	2	
		Professional Elective IV																
		Open Elective-II																
		Digital Image Processing Laboratory	2	3	3	2	3	3	3	3	2	2	2	1	2	3	3	3
		Project Work-Phase I	3	3	3	3	3	2	3	3	3	3	3	3	3	3	3	3
		Hospital Internship	3		3	3		3	3	3	3	3		3	3	2		2
Year IV	Sem VIII	Professional Elective V																
		Professional Elective VI																
		Project Work Phase II	3	3	3	2	3	2	2	2	3	1	3	3	3	3	3	3

1 - Reasonable, 2 - Significant, 3 - Strong

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B.E. MEDICAL ELECTRONICS
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI (I TO VIII SEMESTERS)

SEMESTER I

S.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**	**1**	**12**	**24**

SEMESTER II

S.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
PRACTICALS								
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**	**1**	**14**	**26**

Conducted after college hours

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	1907303	Electrical and Electronic Measurements	PC	3	3	0	0	3
3	1910301	Analog Electronics	PC	3	3	0	0	3
4	1906303	Digital Electronics	PC	3	3	0	0	3
5	1910302	Anatomy and Human Physiology	PC	3	3	0	0	3
6	1906001	Signals and Systems	PC	3	3	0	0	3
PRACTICAL								
7	1907306	Instrumentation 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**	**1**	**10**	**23**

SEMESTER IV

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	1906401	Linear Integrated Circuits	PC	3	3	0	0	3
3	1905408	Electrical Engineering	ES	3	3	0	0	3
4	1910401	BioMaterials and Artificial Organs	PC	3	3	0	0	3
5	1905009	Control Systems Engineering	PC	3	3	0	0	3
6	1915001	Professional Ethics	HS	3	3	0	0	3
PRACTICAL								
7	1906003	Digital Signal Processing Laboratory	PC	4	0	0	4	2
8	1906405	Linear Integrated Circuits Laboratory	PC	4	0	0	4	2
TOTAL				**26**	**18**	**0**	**8**	**22**

SEMESTER V

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	1910501	Therapeutic Equipments	PC	3	3	0	0	3
2	1910502	Medical Instrumentation	PC	3	3	0	0	3
3	1906509	Analog and Digital Communication	PC	3	3	0	0	3
4	19xxxx	Professional Elective – I	PE	3	3	0	0	3
5	19xxxx	Professional Elective – II	PE	3	3	0	0	3
6	19xxxx	Open Elective –I	OE	3	3	0	0	3
PRACTICAL								
7	1910505	Medical Equipment Laboratory	PC	4	0	0	4	2
8	1910506	Medical Instrumentation Laboratory	PC	4	0	0	4	2
9	1919002	Professional Communication	EEC	2	0	0	2	1
TOTAL				**28**	**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	1910601	Human Assist Devices	PC	3	3	0	0	3
3	1910602	Medical Imaging Techniques	PC	3	3	0	0	3
4	1910603	Biomechanics	PC	3	3	0	0	3
5	1908609	Internet of Things and its Applications	PC	3	3	0	0	3
6	19xxxxx	Professional Elective-III	PE	3	3	0	0	3
PRACTICAL								
7	1906611	Microprocessors and Microcontrollers Laboratory	PC	4	0	0	4	2
8	1910604	Medical Electronics System Design Laboratory	PC	4	0	0	4	2
9	1910605	Mini Project	EEC	4	0	0	4	2
TOTAL				**30**	**18**	**0**	**12**	**24**

SEMESTER VII

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	1906704	Digital Image Processing	PC	3	3	0	0	3
2	1910701	Physiological Modelling	PC	3	3	0	0	3
3	1910702	Body Area Networks	PC	3	3	0	0	3
4	19xxxxx	Professional Elective IV	PE	3	3	0	0	3
5	19xxxxx	Open Elective-II	OE	3	3	0	0	3
PRACTICAL								
6	1910706	Digital Image Processing Laboratory	PC	4	0	0	4	2
7	1910708	Project Work - Phase I	EEC	4	0	0	4	2
8	1910709	Hospital Internship	EEC	0	0	0	0	1
TOTAL				**23**	**15**	**0**	**8**	**20**

SEMESTER VIII

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	19xxxx	Professional Elective V	PE	3	3	0	0	3
2	19xxxx	Professional Elective VI	PE	3	3	0	0	3
PRACTICAL								
3	1910810	Project Work - Phase II	EEC	12	0	0	12	6
TOTAL				**18**	**6**	**0**	**12**	**12**

TOTAL NO. OF CREDITS: 174

HUMANITIES AND SOCIAL SCIENCES (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	3	1	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	3	1	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	1918301	Transforms and Partial Differential Equations	BS	4	3	1	0	4
9	1901209	Applied Physics & Environmental Science Laboratory	BS	4	0	0	4	2

ENGINEERING SCIENCES (ES)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1901006	Programming in C	ES	3	3	0	0	3
2	1901007	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
8	1905408	Electrical Engineering	ES	3	3	0	0	3

PROFESSIONAL CORE (PC)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1907303	Electrical and Electronic Measurements	PC	3	3	0	0	3
2	1910301	Analog Electronics	PC	3	3	0	0	3
3	1906303	Digital Electronics	PC	3	3	0	0	3
4	1910302	Anatomy and Human Physiology	PC	3	3	0	0	3
5	1906001	Signals and Systems	PC	3	3	0	0	3
6	1907306	Instrumentation Laboratory	PC	4	0	0	4	2
7	1906305	Analog and Digital Electronics Laboratory	PC	4	0	0	4	2
8	1906002	Discrete-Time Signal Processing	PC	3	3	0	0	3
9	1906401	Linear Integrated Circuits	PC	3	3	0	0	3
10	1910401	BioMaterials and Artificial Organs	PC	3	3	0	0	3
11	1905009	Control Systems Engineering	PC	3	3	0	0	3
12	1906003	Digital Signal Processing Laboratory	PC	4	0	0	4	2
13	1906405	Linear Integrated Circuits Laboratory	PC	4	0	0	4	2
14	1910501	Therapeutic Equipments	PC	3	3	0	0	3
15	1910502	Medical Instrumentation	PC	3	3	0	0	3
16	1906507	Analog and Digital Communication	PC	3	3	0	0	3
17	1910505	Medical Equipment Laboratory	PC	4	0	0	4	2
18	1910506	Medical Instrumentation Laboratory	PC	4	0	0	4	2
19	1906601	Microprocessors and Microcontrollers	PC	3	3	0	0	3
20	1910601	Human Assist Devices	PC	3	3	0	0	3
21	1910602	Medical Imaging Techniques	PC	3	3	0	0	3
22	1910603	Biomechanics	PC	3	3	0	0	3
23	1908609	Internet of Things and its Applications	PC	3	3	0	0	3
24	1906611	Microprocessors and Microcontrollers Laboratory	PC	4	0	0	4	2
25	1910604	Medical Electronics System Design Laboratory	PC	4	0	0	4	2
26	1906704	Digital Image Processing	PC	3	3	0	0	3
27	1910701	Physiological Modelling	PC	3	3	0	0	3
28	1910702	Body Area Networks	PC	3	3	0	0	3
29	1910706	Digital Image Processing 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	1910605	Mini Project	EEC	4	0	0	4	2
4	1910708	Project Work - Phase I	EEC	4	0	0	4	2
5	1910709	Hospital Internship	EEC	0	0	0	0	1
6	1910810	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 ELECTIVE – I (V SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1910503	Bio MEMS	PE	3	3	0	0	3
2	1905510	Electrical Safety and Quality Assurance	PE	3	3	0	0	3
3	1907002	Robotics and Automation	PE	3	3	0	0	3
4	1921503	Nanotechnology and Applications	PE	3	3	0	0	3
5	1915004	Human Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – II (V SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1915006	Hospital Management	PE	3	3	0	0	3
2	1908508	Brain Computer Interface and its Applications	PE	3	3	0	0	3
3	1906004	Electronics Packaging and Testing	PE	3	3	0	0	3
4	1908509	Virtual Reality and Augmented Reality	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – III (VI SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1903612	Disaster Management	PE	3	3	0	0	3
2	1915002	Principles of Management	PE	3	3	0	0	3
3	1904609	Soft Computing	PE	3	3	0	0	3
4	1920001	Fundamentals of Nanoscience	PE	3	3	0	0	3
5	1904606	Intellectual Property Rights	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – IV (VII SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1906008	Embedded and Real Time Systems	PE	3	3	0	0	3
2	1904006	Artificial Intelligence	PE	3	3	0	0	3
3	1915007	Hospital Waste Management	PE	3	3	0	0	3
4	1904012	Machine Learning	PE	3	3	0	0	3
5	1907003	Process Modelling and Simulation	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – V (VIII SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1910801	Medical Informatics	PE	3	3	0	0	3
2	1910802	Fundamentals of Nutrition	PE	3	3	0	0	3
3	1910803	Biometric Systems	PE	3	3	0	0	3
4	1910804	Fiber Optics and Lasers in Medicine	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE – VI (VIII SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1910805	Neural Networks and its Applications	PE	3	3	0	0	3
2	1910806	Bio signal Processing	PE	3	3	0	0	3
3	1910807	Medical Expert Systems	PE	3	3	0	0	3
4	1910808	Telehealth Technology	PE	3	3	0	0	3
5	1910809	Wearable Systems	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.	1906507	Entertaintronics	ECE	3	3	0	0	3
13.	1906505	Photonic Networks	ECE	3	3	0	0	3
14.	1906506	Telecommunication Network Management	ECE	3	3	0	0	3
15.	1907503	Sensors and Transducers	EIE	3	3	0	0	3
16.	1907504	Instrumentation in Biomedical Engineering	EIE	3	3	0	0	3
17.	1908001	3D Printing and Design	IT	3	3	0	0	3
18.	1908002	Scripting Languages	IT	3	3	0	0	3
19.	1909510	Product Design and Development	MECH	3	3	0	0	3
20.	1909511	Vibration and Noise Control	MECH	3	3	0	0	3
21.	1909512	Industrial Safety Engineering	MECH	3	3	0	0	3
22.	1920501	Nanotechnology	PHYSICS	3	3	0	0	3
23.	1920502	Microscopy	PHYSICS	3	3	0	0	3
24.	1921501	Advanced Engineering Chemistry	CHEMISTRY	3	3	0	0	3
25.	1921502	Industrial Nanotechnology	CHEMISTRY	3	3	0	0	3

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.	1906705	Acoustics	ECE	3	3	0	0	3
10.	1906706	Visual Communication	ECE	3	3	0	0	3
11.	1906707	MEMS and NEMS	ECE	3	3	0	0	3
12.	1907001	Transducers Engineering	EIE	3	3	0	0	3
13.	1907003	Process Modeling and Simulation	EIE	3	3	0	0	3
14.	1907708	State Variable Analysis and Design	EIE	3	3	0	0	3
15.	1908003	Software Quality Management	IT	3	3	0	0	3
16.	1908004	C # and .Net Programming	IT	3	3	0	0	3
17.	1908005	Virtual Reality	IT	3	3	0	0	3
18.	1909718	Robotics	MECH	3	3	0	0	3
19.	1909719	Testing of Materials	MECH	3	3	0	0	3
20.	1909720	Design of Electric Vehicles	MECH	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

SUMMARY

SL NO.	SUBJECT AREA	CREDIT AS PER SEMESTER								CREDITS TOTAL	%
		I	II	III	IV	V	VI	VII	VIII		
1.	HS	3	3		3					**09**	**5.14%**
2.	BS	12	12	4						**28**	**16.09%**
3.	ES	9	10		3					**22**	**12.64%**
4.	PC			19	16	13	19	11		**78**	**44.57%**
5.	PE					6	3	3	6	**18**	**10.29%**
6.	OE					3		3		**06**	**3.43%**
7.	EEC					1	2	3	6	**12**	**6.89%**
8.	PCD		1							**01**	**0.57%**
	TOTAL	**24**	**26**	**23**	**22**	**23**	**24**	**20**	**12**	**174**	**100%**
9.	**Non Credit / Mandatory**			✓							

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 understand.
- 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.

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 PERIODS: 45

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.
- Speak fluently and express opinions clearly.

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.

REFERENCES:

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

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

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"**, McGraw Hill Education (India) Private Limited, 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, 10thEdition, New Delhi, 2016
2. Ramana B.V, **"Higher Engineering Mathematics"**, Tata McGraw Hill Publishing Company, New Delhi, 2008.
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].Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.

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	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	-	-	-	-

1920103 **ENGINEERING PHYSICS**

L	T	P	C
3	0	0	3

COURSE 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 experiment - I-shaped girders.

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.

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 PERIODS: 45

COURSE 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.
- 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 MATRIX

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	1	-		1	1	-	-	-	-	1	2	-	-	-
CO 2	3	1	1	-	1	1	1	-	-	-	-	1	3	-	-	-
CO 3	3	-	1	-	-	1		-	-	-	-	1	3	-	-	-
CO 4	3	1	-	1	-	1	1	-	-	-	-	1	3	1	-	-
CO 5	3	1	-	1	-	-	1	-	-	-	-	1	2	-	-	-

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).

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

COURSE 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.

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**
CO 1	2	1	2	1	1	1	1	-	-	-	-	3	1	-	2	1
CO 2	2	1	3	-	2	-	1	-	-	-	-	3	1	-	2	-
CO 3	1	-	1	1	-	-	-	-	-	-	-	2	-	1	1	1
CO 4	2	2	2	-	1	1	1	-	-	-	-	1	-	3	3	-
CO 5	2	-	1	-	-	-	-	-	-	-	-	2	-	2	2	1

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.
- To develop C programs using 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 statement, Iterative statement - 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 PERIODS: 45

COURSE 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. ReemaThareja, —Programming in C, Oxford University Press, Second Edition, 2016.

REFERENCES:

1. Paul Deitel and Harvey Deitel, —C How to Program, Seventh edition, Pearson Publication.

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
CO 1	1	-	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

1901007 **ENGINEERING GRAPHICS** **L T P C**
2 0 4 4

OBJECTIVES:

The main learning objective of this course is to impart knowledge

- 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.

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.

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 PERIODS: 75

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, 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.

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

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 PERIODS: 30

COURSE 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.

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
CO 1	3	1	1	1	-	1	-	1	1	-	-	-	1	-	-	-
CO 2	3	1	1	1	-	1	-	1	1	-	-	-	1	-	-	-
CO 3	3	1	1	1	-	2	-	1	1	-	-	-	2	-	-	-
CO 4	3	1	1	1	-	1	-	1	1	-	-	-	2	-	-	-
CO 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.

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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 PERIODS: 30

COURSE OUTCOMES:

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

TEXTBOOKS:

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

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
CO 1	2	2	1	2	-	-	2	-	-	-	-	1	-	-	-	-
CO 2	3	2	2	2	-	-	2	-	-	-	-	1	-	-	-	-
CO 3	2	2	1	2	-	1	2	-	-	-	-	1	2	3	2	1
CO 4	3	2	3	2	-	1	2	-	-	-	-	1	2	3	2	1
CO 5	2	2	1	2	-	1	2	-	-	-	-	1	2	3	2	1

1901010 **C PROGRAMMING LABORATORY** **L T P C**

(Common to all branches of B.E. / B.Tech. Programmes) **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.
- To develop various applications using array concepts.
- To develop various application using function concept.

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 PERIODS: 60

COURSE 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.
- Develop program using recursion, pointers, and structures.
- Design applications using sequential and random access file processing.

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
CO 1	3	-	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 2	-	-	-	-	2	-	-	-	-	2	-	-	-	-	2	-
CO 3	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	2
CO 4	-	2	-	-	-	2	-	-	-	-	2	-	-	2	-	-
CO 5	-	-	-	-	-	-	-	3	-	-	-	1	2	-	-	-

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

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 PERIODS: 45

COURSE 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.
- Have the ability to write different letters in the expected format

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.

REFERENCES:

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.

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
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

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

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"**, McGraw Hill Education (India) Private Limited, 2019.

REFERENCES:

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.

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
CO 1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO 2	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
CO 3	3	1	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO 4	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
CO 5	3	1	1	1	-	-	-	-	-	-	-	1	-	-	-	-

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 PERIODS: 45

COURSE OUTCOMES:

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.

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
CO 1	3	2	2	-	1	1	1	-	-	-	-	-	3	-	-	-
CO 2	3	2	2	-	-	1	1	-	-	-	-	-	3	-	-	-
CO 3	3	2	2	-	-	1	1	-	-	-	-	-	1	-	-	-
CO 4	3	2	2	-	-	1	1	-	-	-	-	-	2	-	-	-
CO 5	3	2	2	-	1	1	1	-	-	-	-	-	3	1	-	-

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.

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.

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

COURSE 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.

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**
CO 1	1	1	-	-	-	1	2	-	2	-	-	1	1	1	1	1
CO 2	2	2	3	-	-	2	3	-	1	-	-	3	1	3	3	2
CO 3	2	1	2	-	-	2	3	-	2	-	-	3	1	1	1	1
CO 4	1	3	2	-	-		3	-	3	-	-	2	2	3	3	1
CO 5	1	1	1	-	-	1	2	-	-	-	-	1	1	1	1	1

1901005 PROBLEM SOLVING AND PYTHON PROGRAMMING **L T P C**

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

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 PERIODS: 45

COURSE 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.

REFERENCES:

1. Charles Dierbach, **“Introduction to Computer Science using Python: A Computational Problem-Solving Focus**”, Wiley India Edition, 2013.
2. John V Guttag, **“Introduction to Computation and Programming Using Python’’**, Revised and expanded Edition, MIT Press , 2013.
3. Kenneth A. Lambert, **“Fundamentals of Python: First Programs”**, CENGAGE Learning, 2012.

4. Paul Gries, Jennifer Campbell and Jason Montojo, **“Practical Programming: An Introduction to Computer Science using Python 3”**, Second edition, Pragmatic Programmers,LLC,2013.
5. Robert Sedgewick, Kevin Wayne, Robert Dondero, **“Introduction to Programming in Python: An Inter-disciplinary Approach”**, Pearson India Education Services Pvt. Ltd., 2016.

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**
CO 1	3	2	3	-	-	-	1	-	-	-	-	2	2	-	-	3
CO 2	-	-	-	-	2	-	-	-	-	-	-	-	-	2	3	-
CO 3	-	-	-	2	3	-	-	-	-	-	-	-	-	2	-	-
CO 4	-	-	-	-	-	-	-	-	-	2	-	-	-	2	-	-
CO 5	-	-	-	-	-	-	-	-	-	2	2	-	-	-	1	-

1901008 BASIC CIVIL AND MECHANICAL ENGINEERING

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

L	T	P	C
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 and construction methods.
- To enable the students to distinguish the components and working principle of power plant units, boilers and IC engines.
- To understand the concepts and working principle of refrigeration and air conditioning system.

A – OVER VIEW

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.

B – CIVIL ENGINEERING

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.

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 PERIODS: 45

COURSE 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.

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**
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

1901009 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY

L T P C

0 0 4 2

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.

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux.

TOTAL PERIODS: 60

COURSE 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.

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**
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

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.

GROUP A (CIVIL & MECHANICAL)

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.

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.

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, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets
2.	Carpentry vice (fitted to work bench)	15 Nos.
3.	Standard woodworking tools	15 Sets
4.	Models of industrial trusses, door joints, furniture joints	5 each

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	-	-	-

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 PERIODS: 30

DEMO:

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

COURSE 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.

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
CO 1	3	1	2	2	-	1	-	1	1	-	-	-	2	-	-	-
CO 2	3	2	2	2	-	1	-	1	1	-	-	-	2	-	-	-
CO 3	3	2	2	1	-	-	-	1	1	-	-	-	3	-	-	-
CO 4	3	1	2	2	-	1	-	1	1	-	-	-	1	-	-	-
CO 5	3	2	2	2	-	2	-	1	1	-	-	-	2	-	-	-

ENVIRONMENTAL CHEMISTRY LABORATORY

COURSE 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 PERIODS: 30

DEMO:

1. Pollution abatement by adsorption techniques
2. Scintillation Process

COURSE OUTCOMES:

The student should be able to:

- 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:

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

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
CO 1	3	3	3	3	-	3	3	-	-	-	-	1	-	-	-	-
CO 2	3	3	2	3	-	3	3	-	-	-	-	1	-	-	-	-
CO 3	3	3	3	3	-	2	3	-	-	-	-	1	-	-	-	-
CO 4	2	3	3	2	-	3	3	-	-	-	-	2	2	3	2	1
CO 5	3	3	3	3	-	3	3	-	-	-	-	1	-	-	-	-

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.

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.

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

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 PERIODS: 45L +15T

COURSE 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.
- 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.

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**
CO 1	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO 2	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO 3	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO 4	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO 5	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-

1907303 ELECTRICAL AND ELECTRONIC MEASUREMENTS L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn the basics of Measurement Systems.
- Analyze the Characteristics of Instruments.
- Know the relevance of digital instruments in measurements and need for data acquisition systems.
- Understand the basics of storage and display devices.
- Acquire knowledge in industrial instruments.

UNIT – I: INTRODUCTION 9

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement Statistical evaluation of measurement data – Standards and calibration.

UNIT - II: ELECTRICAL AND ELECTRONICS INSTRUMENTS 9

Principle and types of analog and digital voltmeters, ammeters, multimeter – Single and three phase wattmeter and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT - III: COMPARISON METHODS OF MEASUREMENTS 9

D.C & A.C potentiometers, DC Bridges –Wheatstone, Kelvin , AC bridges- Maxwell, Hay, Schering and Wien bridge.– Multiple earth and earth loops - Electrostatic and electromagnetic interference – Grounding techniques.

UNIT - IV: STORAGE AND DISPLAY DEVICES 9

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & dot matrix display – Data Loggers.

UNIT – V: TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Classification of transducers – Passive and Active – variable Resistive, capacitive & inductive transducers and its applications – Strain gauges, Thermistor, RTD, LVDT, capacitor microphone- Thermocouple- Piezoelectric, Photo electric, transducers – Elements of data acquisition system – Smart sensors.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Analyze the functions of different electronic instruments.
- Select right kind of transducers for specific application.
- Design Data Acquisition system.
- Explain various storage and display devices.
- Describe the classification of transducers, industrial instrumentation and DAS.

TEXT BOOKS:

1. E.O. Doebelin, "Measurement Systems – Application and Design", Tata McGraw Hill publishing company, 2003.
2. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', DhanpatRai and Co, 2004.

REFERENCE BOOKS:

1. A.J. Bouwens,"Digital Instrumentation", Tata Mc Graw Hill, 1997.
2. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.
3. H.S. Kalsi, 'Electronic Instrumentation', Second Edition, Tata Mc Graw Hill, 2004.
4. Martin Reissland, "Electrical Measurements", New Age International (P) Ltd., Delhi, 2001.
5. J. B. Gupta, "A Course in Electronic and Electrical Measurements", S. K. Kataria & Sons, Delhi, 2003.

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**
CO 1	3	2	1	1	2	2	-	-	-	-	-	-	3	2	1	1
CO 2	3	3	2	3	2	-	-	2	-	-	-	-	3	3	2	3
CO 3	3	3	2	3	2	-	-	-	-	-	-	-	3	3	2	3
CO 4	2	2	3	2	2	-	-	-	2	-	-	-	2	2	3	2
CO 5	3	3	3	3	3	2	2	1		-	-	-	3	3	3	3

1910301 **ANALOG ELECTRONICS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the biasing methods and emitter follower configuration of BJT transistors.
- To design and examine the characteristics of amplifier circuits.
- To analyze the frequency response of small signal amplifiers.
- To design and analyse feedback concept and oscillator circuits.
- To gain knowledge on power amplifier and voltage regulator.

UNIT – I: BJT AC ANALYSIS 9

BJT Transistor Modeling, The re transistor model, Common emitter fixed bias, Voltage divider bias, Emitter follower configuration. Darlington connection- DC bias; The Hybrid equivalent model, Approximate Hybrid Equivalent Circuit- Fixed bias, Voltage divider, Emitter follower configuration; Complete Hybrid equivalent model, Hybrid π Model.

UNIT – II: FIELD EFFECT TRANSISTORS 9

Construction and Characteristics of JFETs, Transfer Characteristics, Depletion type MOSFET, Enhancement type MOSFET. FET Amplifiers**:** JFET small signal model, Fixed bias configuration, Self bias configuration, Voltage divider configuration, Common Gate configuration. Source- Follower Configuration, Cascade configuration.

UNIT – III: BJT AND JFET FREQUENCY RESPONSE 9

Logarithms, Decibels, Low frequency response – BJT Amplifier with RL, Low frequency response-FET Amplifier, Miller effect capacitance, High frequency response – BJT Amplifier, High frequency response-FET Amplifier, Multistage Frequency Effects.

UNIT – IV: FEEDBACK AND OSCILLATOR CIRCUITS 9

Feedback concepts, Feedback connection types, Practical feedback circuits, Oscillator operation, FET Phase shift oscillator, Wien bridge oscillator, Tuned Oscillator circuit, Crystal oscillator, UJT construction, UJT Oscillator.

UNIT – V: POWER AMPLIFIERS **9**

Definition and amplifier types, Series fed class A amplifier, Transformer coupled class A amplifier, Class B amplifier operation and circuits, Amplifier distortion, Class C and Class D amplifiers. Voltage Regulators: Discrete transistor voltage regulation - Series and Shunt Voltage regulators.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

- Understand the fixed, voltage divider, emitter feedback, collector feedback biasing methods and small signal Analysis of BJT.
- Acquire knowledge on biasing for JFET and MOSFET and Small signal Analysis of MOSFET and JFET.
- Discuss about input and output impedance, gain, bandwidth Large signal Amplifiers.
- Perform the High frequency analysis of BJT and MOSFET.
- Know the different types of oscillators and power amplifiers.

TEXT BOOKS:

1. Donald. A. Neamen, “Electronic Circuits Analysis and Design”, Third Edition, McGraw Hill Education (India) Private Ltd., 2006.
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, Eleventh Edition, Pearson Education, 2013.

REFERENCE BOOKS:

1. Millman J, Halkias C and Sathyabrada Jit, “Electronic Devices and Circuits”, Fourth Edition, McGraw Hill Education (India) Private Ltd., 2015.
2. Salivahanan and N. Suresh Kumar, “Electronic Devices and Circuits”, Fourth Edition, McGraw Hill Education (India) Private Ltd., 2016.
3. Floyd, “Electronic Devices”, Tenth Edition, Pearson Education, 2018.
4. David A. Bell, “Electronic Devices & Circuits”, Fifth Edition, Oxford University Press, 2008.
5. Anwar A. Khan and Kanchan K. Dey, “A First Course on Electronics”, PHI, 2006.

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
CO 1	2	3	3	1	-	2	-	-	-	-	-	2	2	-	-	-
CO 2	2	3	3	1	-	2	-	-	-	-	-	2	2	-	-	-
CO 3	2	3	3	2	-	2	-	-	-	-	-	2	3	-	-	-
CO 4	2	3	3	2	-	2	-	-	-	-	-	1	-	-	-	-
CO 5	2	2	2	3	-	2	-	-	-	-	-	2	1	-	-	-

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.

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

COURSE 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

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	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO 2	3	3	1	2	-	-	-	-	-	-	-	-	2	-	-	-
CO 3	3	3	1	2	-	-	-	-	-	-	-	-	2	1	-	-
CO 4	3	2	3	2	3	2	-	-	-	-	-	1	3	1	2	-
CO 5	3	3	3	2	-	-	-	-	-	-	-	1	2	-	-	-

1910302 **ANATOMY AND HUMAN PHYSIOLOGY** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To identify all the organelles of an animal cell and their function.
- To understand the interactions and signaling made between cells.
- To analyse different cells, tissues, organs and organ systems in body.
- To explore the structure and functions of the various types of systems of human body.
- To acquire knowledge about anatomical features and physiology of human systems.

UNIT – I: CELL AND TISSUE STRUCTURE 9

Structure of Cell –Structure and functions of sub organelles – Cell Membrane –Transport of across Cell Membrane - Action Potential – Cell to Cell Signaling– Cell Division. Types of Specialized tissues – Functions.

UNIT – II: SKELETAL, MUSCULAR AND RESPIRATORY SYSTEMS 9

Skeletal System: Types of Bone and function – Physiology of Bone formation – Division of Skeleton – Types of joints and function – Types of cartilage and function. **Muscular System**: Parts of Muscle – Movements. **Respiratory System**: Parts of Respiratory Systems – Types of respiration - Mechanisms of Breathing – Regulation of Respiration.

UNIT – III: CARDIOVASCULAR AND LYMPHATIC SYSTEMS 9

Cardiovascular System: Components of Blood and functions- Blood Groups and importance – Structure of Heart – Conducting System of Heart – Properties of Cardiac Muscle - Cardiac Cycle - Heart Beat – Types of Blood vessel – Regulation of Heart rate and Blood pressure. **Lymphatic System**: Parts and Functions of Lymphatic systems – Types of Lymphatic organs and vessels.

UNIT – IV: NERVOUS SYSTEMS, ENDOCRINE SYSTEMS AND SENSE ORGANS 9

Nervous System: Cells of Nervous systems – Types of Neuron and Synapses – Mechanisms of Nerve impulse – Brain: Parts of Brain – Spinal Cord – Tract and

Pathways of Spines – Reflex Mechanism – Classification of Nerves - Autonomic Nervous systems and its functions. **Endocrine System**: Pituitary and thyroid gland. **Sense Organs**: Eye and Ear.

UNIT – V: DIGESTIVE AND URINARY SYSTEMS 9

Digestive System: Organs of Digestive system – Digestion and Absorption. **Urinary System**: Structure of Kidney and Nephron – Mechanisms of Urine formation – Regulation of Blood pressure by Urinary System – Urinary reflex.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

- Explain the different organelles in an animal cell, tissues, organs and organ system in human body.
- Analyze the anatomical structure and physiological function of Skeletal, Muscular and Respiratory system.
- Describe the structure and function of Cardiovascular and Lymphatic system.
- Assess the Nervous system and Endocrine system.
- Exhibit the structure and function of Digestive and Urinary system.

TEXT BOOKS:

1. Prabhjot Kaur, "Anatomy and Physiology", Lotus Publishers. 2014.
2. Elaine N, Marieb, "Essential of Human Anatomy and Physiology", Twelfth Edition, Pearson Education, New Delhi, 2017.

REFERENCE BOOKS:

1. Frederic H. Martini, Judi L. Nath, Edwin F. Bartholomew, "Fundamentals of Anatomy and Physiology", Pearson Publishers, 2014.
2. Gillian Pocock, Christopher D. Richards, "The Human Body – An introduction for Biomedical and Health Sciences", Oxford University Press, USA, 2013.
3. William F. Ganong, "Review of Medical Physiology", Twenty second Edition, Mc Graw Hill, New Delhi, 2010.
4. Eldra Pearl Solomon, "Introduction to Human Anatomy and Physiology", W.B.Saunders Company, 2015.
5. Guyton & Hall, "Medical Physiology", Thirteenth Edition, Elsevier Saunders, 2015.

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
CO 1	3	-	-	-	-	-	-	3	-	-	-	-	2	2	-	-
CO 2	3	-	-	2	-	-	-	2	-	-	-	2	2	2	-	-
CO 3	3	-	-	2	-	-	-	2	-	-	-	2	2	2	-	-
CO 4	3	-	-	2	-	-	-	2	-	-	-	2	2	2	-	-
CO 5	3	-	-	-	-	-	-	2	-	-	-	2	2	2	-	-

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

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

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	1	1	-	-	-	-	-	-	-	1	2	2	-	-
CO 2	3	2	1	1	-	-	-	-	-	-	-	1	2	2	-	-
CO 3	3	2	1	1	-	-	-	-	-	-	-	1	2	2	-	-
CO 4	3	2	1	3	-	-	-	-	-	-	-	1	2	2	-	-
CO 5	3	2	1	3	-	-	-	-	-	-	-	3	2	2	-	-

1907306 **INSTRUMENTATION LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

- To study the characteristics of sensors, signal conditioning circuits and their applications.
- To make the students learn about the measurement using sensors and converter.
- To provide knowledge about the principles involved in LVDT.
- To make the students aware about the measurement of resistance, capacitance and inductance using bridge circuits.
- To make the students familiar with analog to digital and digital to analog converters.

LIST OF EXPERIMENTS:

1. Characteristics of strain gauges.
2. Displacement measurement using LVDT.
3. Characteristics of temperature sensors.
4. Measurement of skin temperature – contact method.
5. Measurement of skin temperature – non-contact method.
6. Characteristics of Light sensors-Photodiode, Photo Transistor.
7. Bridge Circuits for Measurement of Resistance, capacitance and inductance.
8. Measurement of Speed & Torque calculation for medical equipment drives.
9. Characteristics of A/D converter.
10. Characteristics of D/A converter.

TOTAL PERIODS: 60

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS

S.No	Name of the equipments / Components	Quantity Required	Remarks
1	Strain gauge Trainer Ki	1	-
2	Loads for measurement	1	-
3	LVDT trainer kit	1	-
4	LVDT sensor	1	-
5	Thermocouple trainer kit	1	-
6	Thermocouple	1	-
7	Thermistor Trainer kit	1	-
8	Thermistor	1	-
9	RTD Trainer Kit	1	-

10	RTD	1	-
11	Thermometer	3	-
12	Heater with water bath	2	-
13	LDR, Photo Diode,Photo Transistor trainer kit	1	-
14	Light Source	1	-
15	Wheatstone bridge, Kelvin‘s Bridge, Schering Bridge, Maxwell Bridge	Each 1	-
16	Decade resistance Box, Decade Inductance Box, Decade Capacitance Box	Each 3	-
17	Voltmeter, Multi meter	Each 10	-
18	Regulated power supply	10	-
19	ICs – A/D and D/A	Each 1	-
20	CRO	10	-
21	Tachometer	1	-
22	Connecting wires Patchcards	-	-

COURSE OUTCOMES:

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

- Design measurement system for various applications.
- Analyze the characteristics of sensors and signal conditioning circuits.
- Understand different temperature measurements.
- Perform A/D and D/A conversion operation.
- Demonstrate measurement using bridge circuits.

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
CO 1	3	3	2	3	2	-	-	1	-	-	-	-	3	3	2	3
CO 2	3	2	1	1	2	2	-	-	-	-	-	-	3	2	1	1
CO 3	3	3	2	3	2	-	2	-	-	-	-	-	3	3	2	3
CO 4	3	2	1	1	2	2	-	-	-	-	-	-	3	2	1	1
CO 5	3	3	2	3	2	2	2	1	-	-	-	-	3	3	2	3

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

COURSE 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 7400/ 7402 / 7404 / 7486 / 7408 / 7432 / 7483 / 74150 /74151 / 74147 / 7445 / 7476/7491/ 555 / 7494 / 7447 / 74180 /7485 / 7473 / 74138 / 7411 / 7474	50 Nos.

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
CO 1	3	2	2	2	3	2	-	-	3	3	-	1	3	3	3	1
CO 2	3	2	2	2	3	2	-	-	3	2	-	2	3	3	3	1
CO 3	3	2	2	2	3	2	-	-	2	3	-	2	3	3	3	1
CO 4	3	2	2	3	3	2	-	-	3	3	-	3	3	3	3	1
CO 5	3	2	3	3	3	2	-	-	3	2	-	2	3	3	3	1

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.

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.

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.

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

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.

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, 8th 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.

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

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.

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

COURSE 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.
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

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

1905408 **ELECTRICAL ENGINEERING** **L T P C**

3 0 0 3

OBJECTIVES:

- To introduce the fundamental concepts of electrical circuits connections with load.
- To understand the basic theory, operational characteristics of AC and DC machines.
- To study the operating principles of measuring instrument for V, I, energy, power.
- To create awareness on the methods for electrical safety, load protection.
- To observe the electricity supply sources based on classical and standalone systems.

UNIT-I: ELECTRICAL CIRCUITS AND ANALYSIS 9

Ohm‘s law, DC and AC circuits fundamentals, Energy sources, Kirchhoff's laws, Mesh and Nodal analysis, Star -delta and Delta -star transformation; theorems and simple problems :Superposition, Thevenin's, Maximum power transfer theorem.

UNIT-II: ELECTRICAL MACHINES 9

DC Machines: D.C generators &D.C motors: Principle of operation, constructions, types, Applications -A.C Machines: Types-Introduction to Alternators-Single Phase and Three phase induction motors: principle of operation, Types and Applications-Transformers: Principles of operation, Constructional Details, Types and Applications.

UNIT III BASIC ELECTRICAL INSTRUMENTATION 9

Introduction, classification of instruments, operating principles, essential features of measuring instruments (elementary Treatment only)- Moving coil, permanent magnet (PMMC) instruments, Moving Iron of Ammeters and Voltmeters Energy meter, Current Transformer, Potential Transformer.

UNIT-IV: ELECTRICAL WIRING AND SAFETY 9

Cable and wire types and applications, Service mains, meter board and distribution board. Brief discussion on concealed conduit wiring. Two-way and three-way control. Elementary discussion on Circuit protective devices: fuse and Miniature Circuit Breaker (MCB‘s). Electric shock, precautions against shock, Objectives for Neutral and Earthing, types of earthing; pipe and plate earthing, Residual current circuit breaker.

UNIT-V: ELECTRICAL POWER SYSTEM AND ITS APPLICATION 9

Introduction to Power generation, distribution and Transmission. Power supply circuits with SMPS, UPS, Batteries, Power Tariffs, EMI and EMC.

TOTAL PERIODS : 45

COURSE OUTCOMES:

- Design simple electrical circuits and understand through nodal, mesh analysis about constructing series and parallel configuration of circuits with sources and variable loads.
- Get knowledge on electrical machines and on its efficient operating principle.
- Understand operating principles of measuring instrument for V, I, energy, power.
- Gain knowledge on safety measures while working with electrical circuits.
- Analyze existing power distribution and hence apply technology in electrical Applications.

TEXTBOOKS:

1. Dr. D P Kothari, Prof I J Nagrath, “Basic Electrical Engineering” , 3rd Edition, Tata McGraw- Hill, 2009.
2. P.C. Sen, “Principles of Electrical Machines and Power Electronics”, Wiley , 2016 (Reprint).

REFERENCE BOOKS:

1. Joseph Edminister, Mahmood Nahvi, “Schaum's Outline of Electromagnetics”, 4th Edition, Tata McGraw-Hill, 2013.
2. Vijay Kumar Garg, Basic Electrical Engineering (A complete Solution), Wiley Reprint 2015.
3. C.L. Wadhwa, Basic Electrical Engineering, Fourth Edition, New Age International Publication, 2007.

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

1910401 BIOMATERIALS AND ARTIFICIAL ORGANS

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made:

- To learn characteristics and classification of Biomaterials.
- To understand different metals, ceramics and its nanomaterial's characteristics as biomaterials.
- To acquire knowledge about polymeric materials and combinations that could be used as a tissue replacement implants.
- To gain an overview of artificial organs & transplants.
- To study about soft tissue replacement and hard tissue replacement.

UNIT – I: INTRODUCTION TO BIO-MATERIALS 9

Definition and classification of bio-materials, Mechanical properties, Viscoelasticity, Biomaterial performance, Body response to implants, wound healing, Blood compatibility, Nano scale phenomena.

UNIT – II: METALLIC AND CERAMIC MATERIALS 9

Metallic implants - Stainless steels, co-based alloys, Ti-based alloys, shape memory alloy, nanostructured metallic implants, degradation and corrosion, ceramic implant – bioinert, biodegradable or bioresorbable, bioactive ceramics, nanostructured bioceramics.

UNIT – III: POLYMERIC IMPLANT MATERIALS 9

Polymerization, factors influencing the properties of polymers, polymers as biomaterials, biodegradable polymers, Bio polymers: Collagen, Elastin and chitin. Medical Textiles, Case study of organ regeneration.

UNIT – IV: ARTIFICIAL ORGANS AND TRANSPLANTS 9

ARTIFICIAL ORGANS: Introduction, outlook for organ replacements, design consideration, evaluation process.

TRANSPLANTS: Overview, Immunological considerations, Blood transfusions, individual organs – kidney, liver, heart and lung, bone marrow, cornea.

UNIT – V: IMPLANTABLE MEDICAL DEVICES AND ORGANS 9

Gastrointestinal system, Dentistry, Maxillofacial and craniofacial replacement, Soft tissue repair, replacement and augmentation, recent advancement and future directions.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

- Analyze different types of Biomaterials and its classification.
- Identify different metals, ceramics and its nanomaterial characteristics as biomaterials.
- Perform combinations of materials that could be used as a tissue replacement implant.
- Gain adequate knowledge about artificial organs & transplants.
- Know the different types of soft tissue replacement and hard tissue replacement.

TEXT BOOKS:

1. Sujata V. Bhatt, “Biomaterials”, Second Edition, Narosa Publishing House, 2005.
2. Sreeram Ramakrishna, Murugan Ramalingam, T. S. Sampath Kumar, and Winston O. Soboyejo, “Biomaterials: A Nano Approach”, CRC Press, 2010.
3. Park J.B., “Biomaterials Science and Engineering”, Plenum Press, 1984.

REFERENCE BOOKS:

1. Myer Kutz, “Standard Handbook of Biomedical Engineering & Design”, McGraw Hill, 2003.
2. J D Bronzino, “Biomedical Engineering handbook Volume”, (CRC Press / IEEE Press), 2000.
3. R S Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, 2003.
4. Kopff W.J, “Artificial Organs”, First edition, John Wiley and sons, New York, 1976.
5. Yannas, I. V, “Tissue and Organ Regeneration in Adults”, New York, NY: Springer, 2001. ISBN: 9780387952147.

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

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.

UNIT-V: CONTROL SYSTEM ANALYSIS USING 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 PERIODS: 45

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.

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

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 PERIODS: 45

COURSE 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.

REFERENCES:

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).

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

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.

TOTAL PERIODS:60

COURSE 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.
- 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
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

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

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:

15. Simulation of Active low-pass, High-pass and band-pass filters using Op-amp.
16. Simulation of Astable and Monostable multivibrators using NE555 Timer.
17. Simulation of A/ D converter.
18. Simulation of Analog multiplier.

TOTAL PERIODS:60

COURSE 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

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

1910501 **THERAPEUTIC EQUIPMENTS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To gain knowledge on basic concepts of therapeutic equipments.
- To understand the cardiac and respiratory assist devices.
- To acquire knowledge about the various diathermy techniques and extra corporeal devices.
- To explore the medical equipment used in radiotherapy.
- To comprehend the radiation protection principles and radiation safety in medicine.

UNIT - I: CARDIAC ASSIST DEVICES 9

Cardiac pacemakers-Need, types and functional characteristics, AC Cardiac defibrillators, disadvantages, DC defibrillator, types- Instantaneous, Cardioverter.

UNIT - II: DIATHERMY AND MEDICAL STIMULATORS 9

IR and UV lamp and its application. Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Electro surgery machine - Current waveforms, Tissue Responses, Electro surgical current level, Hazards and safety procedures. Electric stimulators- current waveforms-Galvani, Faradic, exponential surged-IFT and TENS-Lithotripsy- Therapeutic applications of laser.

UNIT - III: EXTRACORPOREAL DEVICES 9

Indication and principle of Haemodialysis, Dialysate, different types of Hemodialyzers, peritoneal dialyser monitoring systems, Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators, finger pump, roller pump, monitoring systems.

UNIT - IV: RESPIRATORY AIDS 9

Ventilator- Need, Types, Intermittent positive pressure, breathing apparatus operating sequence, electronic IPPB unit with monitoring for all respiratory parameters, Humidifier, Nebulizer, Aspirator, Infant incubators.

UNIT - V: RADIATION THERAPY AND RADIATION SAFETY 9

Effects of ionising radiation, Radiation therapy – Cobalt, Cesium therapy, linear accelerator, betatron, cyclotron, brachytherapy. Radiation safety-Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, Radiation protection in medicine-radiation protection principles, ICRP regulation, Protection methods.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Explain the basic principles of cardiac and respiratory assist devices.
- Analyze the function of therapeutic equipments.
- Interpret the operation of extra corporeal devices.
- Examine the functions of radiotherapy equipments.
- Explore the radiation safety principles and radiation protection methods.

TEXT BOOKS:

1. John G. Webster, “Medical Instrumentation: Application and Design”, Fifth edition, John Wiley & Sons- Inc, 2020.
2. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Fifth edition, Tata McGraw-Hill, New Delhi, 2014.
3. Joseph. J. Carr and John. M. Brown, “Introduction to Biomedical Equipment Technology”, Fourth edition, John Wiley & Sons Inc, New York, 2002.

REFERENCE BOOKS:

1. Leslie Cromwell, Fred. J. Weibell, Erich. A. Pfeiffer, “Biomedical Instrumentation and Measurements”, Second edition, Prentice Hall India, New Delhi, 2014.
2. Albert M. Cook and Webster J. G, “Therapeutic Medical Devices”, Prentice Hall Inc., New Jersey, 1982.
3. Gopal B. Saha, “Physics and Radiobiology of Nuclear Medicinell”, Fourth edition, Springer, 2016.

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

1910502 **MEDICAL INSTRUMENTATION** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the basic concepts of medical instrumentation.
- To perform Electrical and non-electrical physiological measurements.
- To know about bio-potential electrodes and amplifiers.
- To explore the basic measurements of physiological parameters.
- To acquire knowledge about medical equipment design and developments.

UNIT – I: BASIC CONCEPTS OF MEDICAL INSTRUMENTATION AND BIO SENSORS 9

BASIC CONCEPTS OF MEDICAL INSTRUMENTATION: Terminology of medicine and medical devices, generalized medical instrumentation system, alternative operational modes, medical measurement constraints-classification of biomedical instruments-biostatistics-regulations of medical devices.

BIO POTENTIAL & BIO SENSORS: Origin of bio potential and its propagation. Electrode–skin interface, half-cell potential. Types of electrodes and its application. Recording problems - measurement with two electrodes.

BIOSENSOR: Need of sensors, working principle of biosensor, various types of biosensors and its applications, bio transducers, bio interface.

UNIT – II: ELECTRODE CONFIGURATIONS & BIO AMPLIFIER 9

Bio signals 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.

BIO AMPLIFIER: Need for bio-amplifier - single ended bio-amplifier, differential bio-amplifier, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier.

UNIT – III: MEASUREMENTS OF BLOOD PRESSURE, BLOOD VOLUME AND CARDIAC OUTPUT 9

PRESSURE: Direct and indirect measurements-harmonic analysis of blood pressure waveforms-heart sounds-phonocardiography.

Blood volume: Electromagnetic flow meters-ultrasonic flowmeters-chamber plethysmography-photo plethysmography.

CARDIAC OUTPUT MEASUREMENTS: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurement.

UNIT – IV: CLINICAL LABORATORY INTRUMENTS 9

Blood gas and acid base Physiology –Electro chemical sensor chromatology-electrophoresis -Blood cell counter, Auto analyzer,Centrifuge, Blood gas analyzers, colorimeter, flame photometer, spectrophotometer.

UNIT – V: DESIGN AND DEVELOPMENT OF BIOMEDICAL DEVICES AND SYSTEMS 9

The Essentials of Design—Overview- Biomedical Engineering Design in Industrial Context- Fundamental Design Tools- Product Definition- Product Development-Hardware Development Methods and Tools- Software Development Methods and Tools-Biomaterials and Material Testing- Biological Engineering Designs. **Developing Biomedical Devices-** Emerging Issues in Healthcare- Innovation and Rights- Industrial Designs- Patent Classification- Examples of Industrial Design Requirements Evaluations.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

- Define basic medical terms and physical values that can be handled by medical instrumentation.
- Understand the basics of bio potentials & importance of its measuring and amplifications.
- Analyze the importance of basic physiological parameter.
- Know the concepts of medical imaging & its clinical importance.
- Design, Development, Testing tools & software requirement for biomedical devices.

TEXT BOOKS:

1. Paul H. King, Richard C. Fries, Arthur T. Johnson, “Design of Biomedical Devices and Systems”, Third Edition, CRC Press, 2014.

2. John G. Webster, “Medical Instrumentation: Application and Design”, Fourth Edition, John Wiley& sons, 2009.

REFERENCE BOOKS:

1. Steven Schreiner, Joseph D. Bronzino, Donald R. Peterson, “Medical Instruments and Devices: Principles and Practices”, First Edition, CRC Press, 2017.
2. Andreoni, Giuseppe, Barbieri, Massimo, Colombo, Barbara-poliMI, “Developing Biomedical Devices-Design, Innovation and Protection”, Springer Briefs, 2014.
3. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Fifth edition, Tata McGraw-Hill, New Delhi, 2014.

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

1906509 **ANALOG AND DIGITAL COMMUNICATION** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand analog communication techniques.
- Explore digital communication techniques.
- Learn data and pulse communication techniques.
- Be familiarized with source and Error control coding.
- Gain knowledge on multi-user radio communication.

UNIT - I: ANALOG COMMUNICATION 9

Amplitude Modulation – AM, DSBSC, SSBSC, VSB –Angle modulation – PM and FM – Super heterodyne receivers.

UNIT - II: PULSE MODULATION 9

Low pass sampling theorem – Quantization – PAM – Line coding – PCM, DPCM, DM, and ADPCM and ADM.

UNIT - III: DIGITAL COMMUNICATION 9

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – Bandwidth Efficiency–Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT - IV: SOURCE AND ERROR CONTROL CODING 9

Entropy, Source encoding theorem, Shannon fano coding, Huffman coding, mutual information, channel capacity, Error Control Coding, linear block codes, cyclic codes.

UNIT - V: MULTI-USER RADIO COMMUNICATION 9

Global System for Mobile Communications (GSM) - Cellular Concept and Frequency Reuse - Channel Assignment and Handover Techniques - Overview of Multiple Access Schemes.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Apply analog communication techniques.
- Examine digital communication techniques.
- Observe the data and pulse communication techniques.
- Analyze Source and Error control coding.
- Utilize multi-user radio communication.

TEXT BOOKS:

1. Wayne Tomasi, “Advanced Electronic Communication Systems”, 6th Edition, Pearson Education, 2009.
2. Blake, “Electronic Communication Systems”, Thomson Delmar Publications, 2002.

REFERENCE BOOKS:

1. Simon Haykin, “Communication Systems”, 4th Edition, John Wiley & Sons, 2004.
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007.
3. H.Taub, D L Schilling and G Saha, “Principles of Communication”, 3rd Edition, Pearson Education, 2007.
4. B. P.Lathi, “Modern Analog and Digital Communication Systems”, 3rd Edition, Oxford University Press, 2007.
5. Martin S.Roden, “Analog and Digital Communication System”, 3rd Edition, Prentice Hall of India, 2002.
6. B.Sklar,”Digital Communication Fundamentals and Applications” 2nd Edition Pearson Education 2007.

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

1910505 **MEDICAL EQUIPMENT LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

The student should be made:

- To familiarize with the biosignals such as ECG and EEG.
- To provide practice on recording and analysis of different Bio potentials.
- To study the function of different Therapeutic equipments.
- To perform electrical safety measurements of any medical equipments.
- To work with drug delivery system and to understand the measurements involved in it.

LIST OF EXPERIMENTS:

1. Simulation of ECG – detection of QRS complex and heart rate.
2. Study of shortwave and ultrasonic diathermy.
3. Study of biotelemetry.
4. Electrical safety measurements.
5. Measurement of Respiratory parameters using spirometry.
6. Study of medical stimulator.
7. Study of ESU – cutting and coagulation modes.
8. Recording of Audiogram.
9. Design of ECG amplifier, recording and analysis using Lab View.
10. A visual acuity measurement.
11. Simulation of EEG – record the EEG waveforms.
12. Measurement of drug delivery system by using syringe pump.
13. Measurement of drug delivery system by using infusion pump.
14. Study of OPG-Orthopantomogram.

TOTAL PERIODS: 60

COURSE OUTCOMES:

The student should be able to:

- Analyze the various Bio medical signals such as ECG, EEG.
- Do recording and analysis of different Bio potentials.
- Check the electrical safety of any medical equipment.
- Explain about the concept and use of therapeutic equipments.

- Perform measurements in drug delivery systems.

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

S.NO	NAME OF THE EQUIPMENT	REQUIRED
8.	Multioutput power supply (+15v, -15v, +30V variable, +5V, 2A)	2 Nos
9.	Short wave Diathermy	1 No
10.	Ultrasound diathermy	1 No
11.	Single parameter biotelemetry system	1 No
12.	Electrical Safety Analyser	1 No
13.	Spirometry with associated analysis system	1 No
14.	ECG Simulator	1 No
15.	Medical stimulator	1 No
16.	Surgical diathermy with analyzer	1 No
17.	Audiometer	1 No
18.	Lab View and visual acuity measurement kit	1 No
19.	Syringe pump	1 No
20.	Infusion pump	1 No

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

1910506 MEDICAL INSTRUMENTATION LABORATORY

L	T	P	C
0	0	4	2

OBJECTIVES:

The student should be made:

- To introduce the students to the application of biomedical instrumentation.
- To learn the practical aspects of various medical transducers and their characteristics.
- To impart knowledge in measurement of Resistance, Inductance and Capacitance using bridges.
- To explore the application of sensors and transducers in the physiological parameter measuring system.
- To understand the basic principles and phenomena in the area of medical diagnostic instrumentation.

LIST OF EXPERIMENTS:

Design and Testing of the following Circuits,

1. Simple Op Amp Circuit Measurements.
2. Design and analysis of biological pre-amplifiers.
3. Experiment of Thermistors.
4. Blood pressure measurement.
5. Experiment of Photo-plethysmography.
6. Recording of ECG signal and analysis.
7. Recording of EMG-Signal.
8. Recording of various physiological parameters using patient monitoring system and telemetry units.
9. Measurement of respiration rate.
10. Measurement and recording of peripheral blood flow.
11. Study of characteristics of optical Isolation amplifier.
12. Measurement of PH and Conductivity.
13. Measurement of Blood Glucose.

TOTAL PERIODS: 60

COURSE OUTCOMES:

The student would be able to:

- Measure various physiological parameters of the body.
- Know the importance of Amplifier and the need of bio signal amplifications.
- Design the amplifier for Bio signal measurements.
- Examine the biochemical parameters.
- Perform Recording and analysis of bio signals.

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

S.NO	NAME OF THE EQUIPMENT	REQUIRED
1.	Op amp kit	1 No.
2.	Thermistor setup	1 No.
3.	Spigmomanometer	1 No.
4.	Photo-plethysmographunit	1 No.
5.	Multiparameter patient monitoring system	1 No.
6.	Respiration measurement kit	1 No.
7.	ECG recorder	1 No.
8.	EMG recorder	1 No.
9.	Blood flow measurement system using ultrasound transducer	1 No.
10.	Function Generators	10 Nos.
11.	Glucometer	1 No.
12.	PH and conductivity Meter	1 No.
13.	DSOs	1 No.
14.	Regulated Power supplies	10 Nos.
15.	Bread boards	15 Nos.
16.	IC 741	

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

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

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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

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

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

COURSE 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,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

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.

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

COURSE 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 McGrawHill, 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.

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	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	-

1910601 **HUMAN ASSIST DEVICES** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To know the principle, design and application of various human assist devices and aids.
- To explore the design aspects of prosthetic and orthotic devices.
- To understand the advancement in visual aids.
- To gain sound knowledge about the constructional and functional characteristics of hearing implants.
- To discuss the importance of rehabilitation and related aspects.

UNIT – I: CARDIAC ASSIST DEVICES 9

Synchronous counter pulsation, assisted through respiration right ventricular by-pass pump, left ventricular bypass pump, open chest and closed chest type, Principle and problems --Intra-Aortic balloon pumping, Veno Arterial Pumping, Prosthetic Cardio Valves, Biomaterials for purposes, its characteristics and testing.

UNIT – II: PROSTHETIC AND ORTHODIC DEVICES PROSTHESIS - INTRODUCTION 9

Incidence and Epidemiology- Rehabilitation of an Amputee- Problems in Stump- Immediate Postoperative Prosthetic Fitting- Prosthesis in Foot and Ankle Amputation (should go to Unit II) Hand and Arm replacement – Different Types of Models, Externally Powered Limb Prosthesis, Introduction to Orthosis- Functions of an Orthosis- Cervical Orthosis- Upper Limb Orthosis- Lower Limb Orthosis- Foot Wear Modifications- Feedback in Orthodic System, Functional Electrical Stimulation, , Materials for Prosthetic and Orthodic devices.

UNIT – III: VISUAL AIDS 9

Ultrasonic and laser canes, Intra ocular lens, Braille Reader, Tactile devices for visually Challenged, Text to voice converter, Screen readers.

UNIT – IV: HEARING AND SPEECH AIDS 9

Audiograms, types of deafness - conductive and nervous, hearing aids - Types, constructional and functional characteristics. Cochlear implants- Need, constructional details, speech trainer.

UNIT – V: REHABILITATION MEDICINE AND ADVOCACY 9

Physiological aspects of Function recovery, Psychological aspects of Rehabilitation therapy, Legal aspect available in choosing the device and provision available in education, job and in day-to-day life.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The students will be made to:

- Be familiar with the role and importance of assist devices.
- Define and explain the basic function of the major components of a prosthesis or orthosis terminology.
- Explore the advancement in visual prosthesis.
- Learn the Constructional and functional characteristics of hearing implants.
- Know the importance of rehabilitation and related aspects.

TEXT BOOKS:

1. Rory A Cooper, "An Introduction to Rehabilitation Engineering", Taylor & Francics, CRC Press, 2006.
2. Kolff W.J, "Artificial Organs", John Wiley and Sons, New York, Edition- 1979.

REFERENCE BOOKS:

1. Joseph D. Bronzino, "The Biomedical Engineering Handbook", Third Edition: Three Volume Set, CRC Press, 2006.
2. R Chinnathurai Jaypee Brothers "Short Textbook of Prosthetics and Orthotics", Medical Publishers (P) Ltd-2010.
3. Andreas.F. Vonracum, "Hand book of Bio material Evaluation", McMillan Publishers, Edition 1980.

4. Albert M. Cook and Webster J. G, ”Therapeutic Medical Devices”, Prentice Hall Inc., New Jersey, Edition- 1992.
5. R.S. Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, 2nd Edition, - 2003.

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

1910602 **MEDICAL IMAGING TECHNIQUES** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To impart knowledge on various imaging techniques used in medical field.
- To explore the concept of various imaging techniques such as radiography, CT, MRI, US, IR and Neuro Magnetic Imaging.
- To apply their knowledge about CT, Radiography, Fluoroscopy and Image quality in medical field.
- To analyze the applicability and performance of various imaging techniques.
- To understand the usage of Radio isotopes and infra-red imaging techniques in medical field.

UNIT – I: RADIOGRAPHY AND FLUOROSCOPY 9

Nature of X-rays- X-Ray absorption – Tissue contrast. X- Ray Equipment – X-Ray Tube, the collimator, Bucky Grid, Digital Radiography- discrete digital detectors, storage phosphor and film scanning, – Fluoroscopy – X-ray Image Intensifier -Digital Fluoroscopy. Angiography, cine Angiography. Digital subtraction Angiography. Mammography.

UNIT – II: COMPUTED TOMOGRAPHY 9

Principles of sectional imaging, Principles of computed Tomographic Imaging - Scan motions, X-ray sources. Influences of Images quality: Unsharpness- contrast - Image Noise-2-D image reconstruction techniques-Back projection and iterative**.**

UNIT – III: MAGNETIC RESONANCE IMAGING AND SPECTROSCOPY 9

Fundamentals of magnetic resonance- overview - Relaxation processes T1 and T2. Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, contrast agents- tissue contrast in MRI- MR angiography, MR spectroscopy, Fmri.

UNIT – IV: RADIO ISOTOPIC IMAGING AND INFRARED IMAGING 9

Radio nuclides for imaging -Rectilinear scanners – linear scanners – Gamma camera –

Emission computed tomography- SPECT, PET- Physics of thermography – imaging systems – pyroelectric vidicon camera clinical, thermography – liquid crystal thermography.

UNIT – V: ULTRASOUND, NEUROMAGNETIC IMAGING 9

Ultrasound: Wave propagation and interaction in Biological tissues -Transducers and imaging systems- Imaging modes- Time required to obtain Images- System components, signal processing -dynamic Range- Ultrasound Image Artifacts- Quality control, Origin of Doppler shift- Limitations of Doppler systems. Neuromagnetic Imaging: Background.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

- Demonstrate the knowledge on a broad understanding of Medical imaging techniques.
- Apply sound knowledge about CT, Radiography, Fluoroscopy and Image quality in analysis.
- Understand the concepts of Neuro Magnetic Imaging, MRI and spectroscopy.
- Analyze the principle and operation modes of Ultrasound Imaging.
- Illustrate the usage of Radio isotopes and infra red imaging techniques in medical field.

TEXT BOOKS:

1. Steve Webb, “The Physics of Medical Imaging”, First Edition, Adam Hilger, Philadelpia, 1988.
2. Jerry L. Prince and Jnathan M.Links, “Medical Imaging Signals and Systems”, Second Edition, Pearson Education Inc., 2014.

REFERENCE BOOKS:

1. William R. Hendee, E. Russell Ritenour, “Medical Imaging Physics”, Fourth Edition, A John Wiley & sons, Inc., 2002.
2. Z.H. Cho., J-oie, P. Jones and Manbir Singh, “Foundations of Medical Imaging”, First Edition, John Wiley and sons Inc, 1993.
3. Avinash C. Kak, Malcolm Shaney, "Principles of Computerized Tomographic Imaging", IEEE Press, Newyork, 1999.

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

1910603 **BIOMECHANICS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- To understand the principles of mechanics.
- To explore the mechanics of physiological systems.
- To understand and analyze the mechanics of joints.
- To illustrate the mathematical models used in the analysis of biomechanical systems.
- To perform design of computer workstation for analysis.

UNIT – I: INTRODUCTION TO MECHANICS 9

Introduction – Scalars and vectors, Statics – Force types, Resolution and composition of forces, Moments of force and couple, Resultant force determination, parallel forces in space, equilibrium of coplanar forces, Dynamics, Basic principles – Linear motion, Newton‘s laws of motion, Impulse and Momentum, Work and Energy Kinetics – Velocity and acceleration, Kinematics – Link segment models, Force transducers, Force plates, Introduction to Constitutive equations – Constitutive equations of Nonviscous fluid, Newtonian Viscous fluid and Hookean Elastic solid.

UNIT – II: BIOFLUID MECHANICS 9

Intrinsic fluid properties – Density, Viscosity, Compressibility and Surface Tension, Viscometers – Capillary, Coaxial cylinder and cone and plate, Rheological properties of blood, Pressure-flow relationship for Non-Newtonian Fluids, Fluid mechanics in straight tube – Steady Laminar flow, Turbulent flow, Flow development, Viscous and Turbulent Sheer Stress, Effect of pulsatility, Boundary Layer Separation, Structure of blood vessels, Material properties and modeling of Blood vessels, Heart –Cardiac muscle characterisation, Native heart valves – Mechanical properties and valve dynamics, Prosthetic heart valve fluid dynamics.

UNIT – III: BIOSOLID MECHANICS 9

Constitutive equation of viscoelasticity – Maxwell &Voight models, anisotropy, Hard Tissues – Structure, blood circulation, elasticity and strength, viscoelastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modeling of Soft Tissues – Cartilage, Tendons and Ligaments Skeletal Muscle – Muscle action, Hill's models, mathematical modeling, Bone fracture mechanics, Implants for bone fractures.

UNIT – IV: BIOMECHANICS OF JOINTS **9**

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, Free body diagrams, Structure of joints, Types of joints, Biomechanical analysis of elbow, shoulder, spinal column, hip, knee and ankle, Lubrication of synovial joints, Gait analysis, Motion analysis using video.

UNIT – V: MODELING AND ERGONOMIC **9**

Introduction to Finite Element Analysis, finite element analysis of lumbar spine; Ergonomics – Musculoskeletal disorders, Ergonomic principles contributing to good workplace design, Design of a Computer work station, Whole body vibrations, Hand transmitted vibrations.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

- Understand the principles of mechanics.
- Outline the principles of biofluid dynamics.
- Explain the fundamentals of bio-solid mechanics.
- Apply the knowledge of joint mechanics.
- Perform computational mathematical modelling applied in biomechanics and design workstation.

TEXT BOOKS:

1. Y.C. Fung, "Bio-Mechanics-Mechanical Properties of Tissues", Second Edition, Springer-Verlag, 1993.
2. Subrata Pal, "Textbook of Biomechanics", Viva Books Private Limited, 2009.

REFERENCE BOOKS:

1. Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers, "Biofluid Mechanics: The Human Circulation", First Edition, Taylor and Francis, 2007.

2. Sheraz S. Malik and Shahbaz S. Malik, “Orthopaedic Biomechanics Made Easy”, Cambridge University Press, 2015.
3. Jay D. Humphrey, Sherry De Lange, “An Introduction to Biomechanics: Solids and Fluids, Analysis and Design”, Second Edition, Springer Science Business Media, 2015.
4. Shrawan Kumar, “Biomechanics in Ergonomics”, Second Edition, CRC Press 2007.
5. Neil J. Mansfeild, “Human Response to Vibration”, First Edition, CRC Press, 2005.
6. Carl J. Payton, Adrian Burden “Biomechanical Evaluation of movement in sports and Exercise”, Second Edition, The British association of sport and exercise science guide, 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	2	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	2	-	-	1
CO3	2	2	1	1	-	-	-	-	-	-	-	-	2	-	1	1
CO4	2	2	1	1	-	-	-	-	-	-	-	-	2	1	1	-
CO5	2	2	3	2	1	1	-	-	-	-	-	-	3	1	1	1

1908609 INTERNET OF THINGS AND ITS APPLICATIONS L T P C

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand Smart Objects and IoT Architectures.
- Learn about various IOT-related protocols.
- Build simple IoT Systems using Arduino and Raspberry Pi.
- Understand data analytics and cloud in the context of IoT.
- 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: CHALLENGES AND DOMAIN SPECIFIC APPLICATIONS IN IoT 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: IoT PROTOCOLS 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: BUILDING IoT PRODUCTS 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: DEVELOPING IoT PROGRAMS 9

Cisco IoT system - IBM Watson IoT platform – Manufacturing - Converged Plantwide Ethernet Model (CPwE) – Power Utility Industry – GridBlocks Reference Model - Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control

TOTAL PERIODS: 45

COURSE OUTCOMES:

At the end of the course, learners will 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 .

REFERENCES:

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.

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

1906611 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY **L T P C**

0 0 4 2

OBJECTIVES:

The student should be made:

- To introduce ALP concepts, features and Coding methods.
- To write ALP for arithmetic and logical operations in 8086 and 8051.
- To differentiate Serial and Parallel Interface.
- To interface different I/Os with Microprocessors.
- To be familiar with MASM.

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. Floating point operations, string manipulations, sorting and searching.
5. Password checking, Print RAM size and system date.
6. Counters and Time Delay.

PERIPHERALS AND INTERFACING EXPERIMENTS:

7. Traffic light controller.
8. Stepper motor control.
9. Digital clock.
10. Key board and Display.
11. Printer status.
12. Serial interface and Parallel interface.
13. A/D and D/A interface and Waveform Generation.

8051 EXPERIMENTS USING KITS AND MASM:

14. Basic arithmetic and Logical operations.
15. Square and Cube program, Find 2‘s complement of a number.
16. Unpacked BCD to ASCII.

TOTAL PERIODS: 60

OUTCOMES:

The student would be able to:

- Write ALP Programmes for fixed and Floating Point and Arithmetic operations.
- Interface different I/Os with processor.
- Generate waveforms using Microprocessors.
- Execute Programs in 8051.
- Explain the difference between simulator and Emulator. .

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

S.NO	NAME OF THE EQUIPMENT	REQUIRED
HARDWARE		
1.	8086 development kits	15 Nos
2.	Interfacing Units	Each 10 Nos
3.	Microcontroller	10 Nos
SOFTWARE		
4.	Intel Desktop Systems with MASM	15 Nos
5.	8086 Assembler	
6.	8051 Cross Assembler	

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

1910604 MEDICAL ELECTRONICS SYSTEM DESIGN LABORATORY L T P C

0 0 4 2

OBJECTIVES:

The student should be made:

- To familiarize with the electronic components used in medical electronics system.
- To enhance the use of sensors used for medical applications.
- To design electronic circuits for various signal processing applications.
- To perform PCB design using software and to explain the various processes involved.
- To provide the knowledge in assembling and testing of the PCB based Medical electronic circuits.

LIST OF EXPERIMENTS:

1. Study of PCB design software (open source) like KiCad, Eagle, etc.
2. Design of a Bio Amplifier.
3. Design of Bio-Electrode Equivalent Circuit.
4. Design and setup a notch filter circuit and Active Band Pass Filter.
5. Design and setup a threshold detector, sample and hold circuit using op-amp.
6. Design and setup a Patient Isolation Circuit.
7. Design of body temperature measuring circuit using thermistors.
8. Design and setup a circuit for skin contact impedance.
9. Design of Plethysmography circuit.
10. Design of Pace Maker circuit.
11. Design of Bio-Telemetry using IC4046.
12. Design a Power Supply for Low Power Wearable Devices.

TOTAL PERIODS:60

OUTCOMES:

The student should be able to:

- Understand the usage of electronic components and medical sensors used in medical electronics system.
- Create electronic circuits for various signal processing applications in medical electronic system.
- Conduct experiments using designed and assembled circuits for medical applications.

- Design and simulate various electronic PCB required for prototyping and testing using software tools and testing equipments.
- Identify, formulate, and solve engineering problems associated with assembly and testing of Medical electronic circuits.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 3 STUDENT PER BATCH

S.NO	NAME OF THE EQUIPMENTS / COMPONENTS	QUANTITY REQUIRED
1	Dual ,(0-30V) variability Power Supply	10
2	CRO (30MHz)	9
3	Digital Multimeter	10
4	Function Generator (1 MHz)	8
5	IC Tester (Analog)	2
6	Bread board	10
7	Computer (KiCad, Eagle installed)	1
8	IC 741, IC NE555, IC 4046	30
9	Transistor, MOSFET, Diode, LED	20
10	Optocouplers	10
11	Thermistor	2
12	Photo transistor	5
13	Vibration or acceleration sensor	5
14	Potentiometer	20
15	Resistors, Capacitor, Inductor	-
16	Step-down transformer 230V/12-0-12V	5
17	Battery	2
18	Single Strand Wire	-

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

1910605 **MINI PROJECT** **L T P C**

0 0 4 2

OBJECTIVES:

The student should be made:

- To estimate the ability of the student in transforming the theoretical knowledge studied so far into a working model of a Biomedical/ Electronics/ Mechatronic/ Instrumentation system.
- To explore new tools, algorithms and techniques required to carry out the projects.
- To acquire knowledge on various procedures for validation of the product and analyze the cost effectiveness.
- To gain experience in organization and implementation of a small project and thus acquire the necessary confidence to carry out main project in the final year.
- To provide guidelines to prepare technical report of the project.

TOTAL PERIODS: 30

COURSE OUTCOMES:

The student should be able to:

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Express the technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
- Prepare report and present the oral demonstrations.

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

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.

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

COURSE 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.

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

1910701 **PHYSIOLOGICAL MODELLING** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To explain the application of Physiological models and vital organs.
- To formulate the methods and techniques for analysis and synthesis of dynamic models.
- To elaborate the dynamic models, simulate and visualize, dynamic responses of physiological models using software.
- To describe nonlinear models of physiological systems.
- To compute the Simulation of physiological systems.

UNIT – I: INTRODUCTION TO PHYSIOLOGICAL MODELING 9

Approaches to modeling: The technique of mathematical modeling, classification of models, characteristics of models. Time invariant and time varying systems for physiological modeling. Introduction to physiology (homeostasis, cell biology) Modeling physical systems, linear models of physiological systems, the Laplace transform, Transfer functions and block diagram analysis Physiology.

UNIT – II: MODELING OF DYNAMIC PHYSIOLOGICAL SYSTEM 9

Dynamic systems and their control, modeling and block diagrams, the pupil control systems (Human Eye), general structure of control systems, the dynamic response characteristics of the pupil control system, open &close loop systems instability, automatic aperture control.

UNIT – III: NONLINEAR MODELS OF PHYSIOLOGICAL SYSTEMS 9

Nonparametric Modeling-Volterra Models. Wiener Models. Efficient Volterra Kernel Estimation. Parametric Modeling- Basic Parametric Model Forms and Estimation Procedures- Volterra Kernels of Nonlinear Differential Equations. Discrete-Time Volterra Kernels of NARMAX Models.

UNIT – IV: COMPARTMENTENTAL PHYSIOLOGICAL MODE 9

Modeling the body as compartments, behaviour in simple compartmental system, pharmacokinetic model, and multi compartmental system. Physiological modeling: Electrical analogy of blood vessels, model of systematic blood flow and model of coronary circulation. Mathematical Modeling of the system: Thermo regulation, Thermoregulation of cold bloodedness& warm bloodedness, the anatomy of thermo regulation, lumping & partial differential equations, heat transfer examples, mathematical model of the controlled process of the body.

UNIT – V: SIMULATION OF PHYSIOLOGICALSYSTEMS 9

Simulation of physiological systems using Open CV / MATLAB software. Biological receptors: -Introduction, receptor characteristics, transfer function models of receptors, receptor and perceived intensity. Neuromuscular model, Renal System, Drug Delivery Model.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to

- Know the relationships between time, Laplace, transform and physiological modeling.
- Analyse the dynamic physiological systems and their control Compartmental analysis of physiological systems.
- Understand the nonlinear models of physiological systems.
- Explore the various approaches and their control Compartmental analysis of physiological systems.
- Determine the functions physiological models using simulations soft wares.

TEXT BOOKS:

1. Michel C Khoo, “Physiological Control Systems-Analysis, simulation and estimation”, Prentice Hall of India, 2001.
2. Marmarelis, “Nonlinear Dynamic Modeling of Physiological Systems”, Wiley-IEEE Press, 2004.

REFERENCE BOOKS:

1. Benjamin C Kuo, “Automatic control systems”, Tenth Edition, McGraw-Hill Education, 2017.

2. David. T. Westwick, Robert E. Kearney, “Identification of Nonlinear Physiological Systems”, Wiley-IEEE Press, 2003.
3. V. Z. Marmarelis, “Advanced methods of physiological modeling”, Springer, 1989.
4. L. Stark, “Neurological Control System”, Plenum Press, 1968.
5. John H Milsum, “Biological control systems”, McGraw Hill 1966.
6. Minrui Fei, Shiwei Ma, Xin Li, Xin Sun, Li Jia and Zhou Su, “Advanced Computational Methods in Life System Modeling and Simulation”, Springer, 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	-	-	3	-	-	-	-	3	-	2	2	2	-	-
CO2	3	3	3	3	3	2	2	2	-	-	-	2	2	2	-	-
CO3	3	3	3	3	3	-	-	-	-	-	-	2	2	2	-	-
CO4	3	3	-	-	3	2	2	2	-	3	-	2	2	2	-	-
CO5	3	3	3	3	3	2	2	-	-	-	-	2	2	2	3	-

1910702 **BODY AREA NETWORKS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To learn about body area networks in health care.
- To enhance the knowledge in the hardware used in BAN.
- To understand the different network standards and topologies.
- To analyze the issues related with BAN.
- To acquire knowledge in the application area of Body Area Networks.

UNIT- I: INTRODUCTION 9

Definition, BAN and Healthcare, Pervasive Patient Monitoring using BAN, Technical Challenges-Sensor design, Biocompatibility, Energy Supply, System security and reliability, ContextAwareness, Integrated Therapeutic Systems, Ideal BSN Architecture.

UNIT- II: HARDWARE FOR BAN 9

Wireless communication - RF communication in Body, Antenna design and testing, Matching Network, Propagation, Materials, Base Station, Power considerations, Wireless communication technologies for wearable systems, Body Area Network – Human Applications.

UNIT- III: NETWORK TOPOLOGIES, PROTOCOLS AND STANDARDS 9

Network Topologies - Stand –Alone BAN, Wireless personal Area Network Technologies. Standards - IEEE 802.15.1, IEEE P802.15.13, IEEE 802.15.14, Zigbee, Healthcare system standards**.**

UNIT – IV: COEXISTENCE ISSUES WITH BAN 9

Interferences – Intrinsic - Extrinsic, Effect on transmission, Regulatory issues-Medical Device regulation in Asia, Security and Self-protection-Bacterial attacks, Virus infection, secured protocols, Self-protection.

UNIT- V: APPLICATIONS OF BAN 9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhymias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, Smart Garments, Electronic pill.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

- Comprehend technical information in body area networks (BAN) in health care.
- Describe the hardware requirements of BAN.
- Review the network topologies, protocols and standards used for BAN.
- Analyze various issues during implementation of BAN.
- Discuss various applications of BAN.

TEXT BOOKS:

1. Guang-Zhong Yang(Ed.), “Body Sensor Networks”, Springer, Second Edition, 2014.
2. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar Venkatasubramanian, “Body Area Networks Safety, Security, and Sustainability”, Cambridge University Press, 2013.

REFERENCE BOOKS:

1. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Springer, 2011.
2. Zhang, Yuan-Ting, “Wearable Medical Sensors and Systems”, Springer, 2013.
3. Mehmet R. Yuce, Jamil Y.Khan, “Wireless Body Area Networks Technology, Implementation and applications”, Pan Stanford Publishing Pte. Ltd, Singapore, 2012.

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

1910706 **DIGITAL IMAGE PROCESSING LABORATORY** **L T P C**

0 0 4 2

OBJECTIVES:

The student should be made:

- To practice the basic image processing techniques.
- To compute the magnitude and phasor representation of images.
- To understand the concepts of image enhancement and restoration.
- To know the concepts of image segmentation methods and compression.
- To explore the applications of image processing techniques.

LIST OF EXPERIMENTS:

Simulation using MATLAB

1. Image sampling and quantization.
2. Analysis of spatial and intensity resolution of images.
3. Intensity transformation of images.
4. DFT analysis of images.
5. Transforms (Walsh, Hadamard, DCT, Haar).
6. Histogram Processing and Basic Thresholding functions.
7. Image Enhancement-Spatial filtering.
8. Image Enhancement- Filtering in frequency domain.
9. Image segmentation – Edge detection, line detection and point detection.
10. Basic Morphological operations.
11. Region based Segmentation.
12. Segmentation using watershed transformation.
13. Analysis of images with different color models.
14. Study of DICOM standards.
15. Image compression techniques.
16. Image restoration.
17. A mini project based on medical image processing.

TOTAL PERIODS: 60

OUTCOMES:

The student would be able to:

- Perform enhancing operations on the image using spatial filters and frequency domain filters.
- Use transforms and analyse the characteristics of the image.
- Perform segmentation operations in the images.
- Estimate the efficiency of the compression technique on the images.
- Apply image processing technique to solve real health care problems.

REFERENCE BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Steven L Eddins, "Digital Image Processing using MATLAB", Second Edition, McGraw Hill Education (India) Private Ltd., 2010.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS 2 STUDENTS PER EXPERIMENT:

S.NO	NAME OF THE EQUIPMENT	QUANTITY
1.	PCs with related accessories	15
2.	MATLAB (licensed) or any equivalent software with Image processing tool box	
3.	Image processing software tools	

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

1910708 **PROJECT WORK PHASE - I** **L T P C**

0 0 4 2

OBJECTIVES:

The student should be made:

- To develop the ability to solve a specific problem right from its identification.
- To consolidate the literature search and formulate the problem for the project Work.
- To design the project to meet specification using the modern tools.
- To construct and develop the project (Product) adhering to the norms and Professional ethics.
- To contribute to the society as an individual or as a team.

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:

The student should be able to:

- Use the 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.

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

1910709 **HOSPITAL INTERNSHIP** **L T P C**

0 0 0 1

OBJECTIVES:

The student should be made:

- To observe medical professionals at work in the wards and the roles of Allied Health Professionals.
- To provide access to healthcare Professionals to get a better understanding of their work.
- To demonstrate patient-care in a hospital setting.
- To troubleshoot, Maintain and calibration of medical machines.
- To understand the importance of engineering services in medical field.

ASSESSMENT:

- Students need to complete training in any leading Multi-specialty hospital for a period of 15 days. They need to prepare an extensive report and submit to their respective course in-charges during the session.
- Out of the following departments, it is mandatory to complete training in any 10. The students can give a presentation of the remaining departments during laboratory hours.

S.NO	**DEPARTMENT OF VISIT**
1.	Cardiology
2.	ENT
3.	Ophthalmology
4.	Orthopaedic and Physiotherapy
5.	ICU/CCU
6.	Operation Theatre
7.	Neurology
8.	Nephrology
9.	Radiology
10.	Nuclear Medicine
11.	Pulmonology
12.	Urology

13.	Obstetrics and Gynaecology
14.	Emergency Medicine
15.	Biomedical Engineering Department
16.	Histo Pathology
17	Biochemistry
18.	Paediatric/Neonatal
19.	Dental
20.	Oncology
21.	PAC‘s
22.	Medical Records / Telemetry

TOTAL PERIODS: 30

OUTCOMES:

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

- Understand the importance of engineering services in medical field.
- Communicate with other health professionals in a respectful and responsible manner.
- Recognize the importance of inter-professional collaboration in healthcare.
- Trouble shooting, Maintenance and calibration of medical machines.
- Maintenance of machine records and tagging or bar code tagging for every machines.

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

1910810 **PROJECT WORK PHASE - II** **L T P C**

0 0 12 6

OBJECTIVES:

The student should be made:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To design solutions for complex engineering problems and meet the specified needs for the public health and safety.
- To create and apply innovative techniques, modern engineering and software tools and model complex engineering activities.
- To demonstrate the principles of engineering and management in a team, to manage projects and in multidisciplinary environments.
- 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

COURSE OUTCOMES:

The student should be able to:

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Express the technical ideas, strategies and methodologies.
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness.

- Take up any challenging practical problems and find solution by formulating proper methodology.

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

PROFESSIONAL ELECTIVES (PE)

SEMESTER V

PROFESSIONAL ELECTIVE I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1910503	Bio MEMS	PE	3	3	0	0	3
2	1905510	Electrical Safety and Quality Assurance	PE	3	3	0	0	3
3	1907002	Robotics and Automation	PE	3	3	0	0	3
4	1921503	Nano Technology and Applications	PE	3	3	0	0	3
5	1915004	Human Rights	PE	3	3	0	0	3

1910503 **BIO MEMS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn various MEMS fabrication techniques.
- Understand different types of sensors and actuators and their principles of operation at the micro scale level.
- Realize the characteristics of fluid flow and actuation through micro channels.
- Study the need and usage of CAD for MEMS design.
- Know the application of MEMS in different field of medicine.

UNIT – I: MEMS MATERIALS AND FABRICATION 9

Typical MEMS and Microsystems, materials for MEMS - active substrate materials - Silicon and its compounds, Silicon piezoresistors, Gallium Arsenide, quartz, polymers. Micromachining photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA.

UNIT – II: MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermomechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beamand cantilever –microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor.

UNIT – III: ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS 9

Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT – IV: MICROFLUIDIC SYSTEMS 9

Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in microconduits, in submicrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectrophoresis, microfluid dispenser, microneedle, micropumps-continuous flow system, micromixers.

UNIT – V: APPLICATIONS OF BIOMEMS 9

CAD for MEMS, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR),DNA sensor, MEMS based drug delivery, Biosensors- sensors for glucose, uric acid, urea and triglyceride sensor.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Discuss various MEMS fabrication techniques.
- Explain different types of sensors and actuators and their principles of operation at the micro Scale level.
- Comprehend the characteristics of fluid flow and actuation through micro channels.
- Explore the need and usage of CAD for MEMS design.
- Design MEMS devices for different medical applications.

TEXT BOOKS:

1. Tai Ran Hsu, “MEMS and Microsystems Design and Manufacture”, First Edition, Tata McGraw Hill Publishing Company, New Delhi, 2002.
2. Wanjun Wang, Stephen A.Soper, “BioMEMS: Technologies and Applications”, First Edition, CRC Press, New York, 2006.

REFERENCE BOOKS:

1. Marc J. Madou, “Fundamentals of Microfabrication: the Science of Miniaturization”, Second Edition, CRC Press, 2002.
2. Nadim Maluf, Kirt Williams. “An introduction to Microelectro Mechancial Systems Engineering”, Second Edition, Artech House Inc, MA, 2004.
3. Chang Liu, “Foundations of MEMS”, Second Edition, Pearson Education, Inc. Upper Saddle River, NJ, 2012.
4. Nitaigour Premchand Mahalik, “MEMS”, McGraw Hill Education, New Delhi, 2007.

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

1905510 ELECTRICAL SAFETY AND QUALITY ASSURANCE L T P C

3 0 0 3

OBJECTIVES:

- To provide knowledge about Electrical hazards.
- To provide knowledge about Indian electricity acts and rules.
- To provide knowledge about electrical protection and maintenance in working environment.
- To provide knowledge about Standarization & Quality Management.
- To provide knowledge about regulatory codes.

UNIT-I: ELECTRICAL HAZARDS 12

Review of Electrical concept, Electrostatic – Electro magnetism – Electrical Hazards – Energy leakage – Clearance and insulation– Current surges – Electrical causes of fire and explosion – Human interface with electricity – Human resistance to electricity.

UNIT-II: STANDARDS AND REQUIREMENTS 12

National electrical Safety code - Standards and statutory requirements – Indian electricity acts and rules – statutory requirements from Electrical inspectorate. Hazardous area classification and classification of electrical equipments for hazardous areas (IS, NFPA, API and OSHA standards).

UNIT-III: ELECTRICAL PROTECTION AND MAINTENANCE 9

Selection of Environment, Protection and Interlock – Discharge rods and earthing device – Safety in the use of portable tools - Preventive maintenance. First aid-cardio pulmonary resuscitation (CPR).

UNIT-IV: STANDARDIZATION OF QUALITY MEDICAL CARE IN HOSPITALS 6

Define Quality- Need for Standarization & Quality Management, QM in Health care organization Quality assurance methods, QA in (Medical Imaging & Nuclear medicine) Diagnostic services – Classification of equipments.

UNIT-V: REGULATORY REQUIREMENT FOR HEALTH CARE 6

FDA regulations, Accreditation for hospitals - JCI, NABH and NABL, Other regulatory Codes.

TOTAL PERIODS: 45

COURSE OUTCOMES:

- Ability to gain knowledge on electrical hazards.
- Ability to gain knowledge about Indian electricity acts and rules.
- Ability to gain knowledge about electrical protection and maintenance in working Environment.
- Ability to know about Standarization & Quality Management in hospitals.
- Ability to know about regulatory codes followed in hospitals.

TEXTBOOKS:

1. B.M.Sakharkar, Principles of Hospital administration and Planning, JAYPEE Brothers, Medical Publishers (P) Ltd. 24.
2. K.Shridhara Bhat, Quality Management, Himalaya Publishing House Cesar A. Cacere & Albert Zana, The Practice of Clinical Engg. Academic press, New York, 1977.

REFERENCE BOOKS:

1. Webster J.G and Albert M.Cook, Clinical Engg, Principles & Practices, Prentice Hall Inc., Engle wood Cliffs, New Jersy, 1979.
2. Karen Parsley, Karen Parsley Philomena Corrigan‖ Quality improvement in Healthcare, 2nd edition,Nelson Thrones Pub, 2002.
3. Sharon Myers —Patient Safety & Hospital Accreditation - A Model for Ensuring Success‖ Springer Publishers 2012.
4. Joseph F Dyro —Clinical Engineering Handbook— Elsevier Publishers, 2004.

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

1907002 ROBOTICS AND AUTOMATION

	L	T	P	C
	3	0	0	3

COURSE 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.

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 PERIODS: 45

COURSE 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

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

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

COURSE OUTCOMES

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

- Describe the basic science behind the properties of materials.
- Interpret the creation, characterization, and manipulation of nanoscale materials.
- Comprehend the exciting applications of nanotechnology at the leading edge of scientific research.
- Apply their knowledge of nanotechnology to identify how they can be exploited for new applications.
- 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

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

1915004 **HUMAN RIGHTS** **L T P C**

3 0 0 3

OBJECTIVE:

- To sensitize the Engineering students to various aspects of Human Rights.
- To educate on the evolution of human rights movement.
- To create awareness and understanding on the international deliberations towards human rights.
- To educate on constitutional rights and provisions related to human rights in India.
- Create awareness on support organisations in Human Rights in India.

UNIT – I: INTRODUCTION 9

Human Rights - Meaning, Origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil, Political Rights, Economic, Social and Cultural Rights, Educational Rights, Collective and Solidarity Rights - Societal problems and human rights.

UNIT – II: EVOLUTION OF HUMAN RIGHTS MOVEMENT 9

Evolution of the concept of Human Rights Magana carta – Geneva Convention1864. Universal Declaration of Human Rights, 1948. Principles of Human Rights - Theories of Human Rights – Feminist Perspectives of Human Rights – Human Rights Problems - Violence against Women and Children, Communal Violence.

UNIT – III: INTERNATIONAL PRESPECTIVES 9

Theories and Perspectives of United Nation Laws – United Nations Agencies to monitor and compliance – United National Commission of Human Rights (UNCHR) – United Nations Children Fund (UNICEF) – United Nations Commission for Refugee (UNHCR) – United Nations Education, scientific and cultural Organisation (UNESCO) – International Labour Organisation and Labour Rights.

UNIT – IV: HUMAN RIGHTS IN INDIA 9

Human Rights in India – Constitutional Provisions / Guarantees. – Fundamental rights, Directive Principles of State, Policies, Fundamental Duties - International

Human Rights and the Indian Constitution – Human Rights violation in Private and Public Domain - Within the Family, by Dominant Castes and Religious Groups,Riots and Violence.

UNIT – V: HUMAN RIGHTS SUPPORT ORGANISATION 9

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

TOTAL PERIODS: 45

OUTCOMES:

- Engineering students will acquire the basic knowledge of human rights.
- Students will have an understanding on the evolution of human rights movement.
- Students will be able to show an understanding on UN laws and agencies related to human rights.
- Students will be able to advocate on constitutional provisions related to human rights in India.
- Students will have understanding on the various organisations involved in support of human rights in India.

REFERENCES:

1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 7th edition 2014.
2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, 'The Future of Human Rights', Oxford University Press, NewDelhi, 3rd edition 2012.

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	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SEMESTER V

PROFESSIONAL ELECTIVE II

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1915006	Hospital Management	PE	3	3	0	0	3
2	1908508	Brain Computer Interface and its Applications	PE	3	3	0	0	3
3	1906004	Electronics Packaging and Testing	PE	3	3	0	0	3
4	1908509	Virtual Reality and Augmented Reality	PE	3	3	0	0	3

1915006 HOSPITAL MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To understand the fundamentals of hospital administration and management.
- To educate students on human resource perspectives.
- To familiarise students on recruitment and training of hospital personnel.
- To explore various information management systems and relative supportive services.
- To learn the modes of communication, quality and safety aspects in hospitals.

UNIT – I: OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning- Equipment Planning – Functional Planning.

UNIT – II: HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager –Human Resource Inventory – Manpower Planning.

UNIT – III: RECRUITMENT AND TRAINING 9

Different Departments of Hospital, Recruitment, Selection, Training Guidelines – Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT – IV: SUPPORTIVE SERVICES 9

Medical Records Department – Central Sterilization and Supply Department – Pharmacy – Food Services - Laundry Services.

UNIT – V: COMMUNICATION AND SAFETY ASPECTS IN HOSPITAL9

Purposes – Planning of Communication, Modes of Communication – Telephone, ISDN, Public Address and Piped Music – CCTV. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules and recycling of medical waste.

TOTAL PERIODS: 45

OUTCOMES:

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

- Understand the principles of Hospital administration.
- Identify the importance of Human resource management.
- Learn Selection and Training aspects in hospitals.
- Have understanding the role of support services in hospitals.
- Understand mode of communication related to aspects of safety.

TEXT BOOKS:

1. D.K. Sharma & R.C. Goyal, "Hospital Administration and Human Resource Management", PHI – 7th Edition,2017.
2. G.D. Kunders, "Hospitals – Facilities Planning and Management – TMH, New Delhi – 10th Reprint 2008.

REFERENCES:

1. Cesar A. Caceres and Albert Zara, "The Practice of Clinical Engineering, Academic Press, New York,1977.
2. Norman Metzger, Handbook of Health Care Human Resources Management ",2nd edition Aspen Publication Inc. Rockville, Maryland, USA,1990.
3. Peter Berman "Health Sector Reform in Developing Countries" - Harvard University Press, 1995.
4. William A. Reinke "Health Planning for Effective Management" - Oxford University Press.1988.
5. Blane, David, Brunner, "Health and SOCIAL Organization: Towards a Health Policy for the 21st Century", Eric Calrendon Press 2002.
6. Arnold D. Kalcizony & Stephen M. Shortell, "Health Care Management", 6th Edition Cengage Learning,2011.
7. Clinical Engineering (Principles and Applications in Engineering), CRC Press; 1st edition (2003).

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

1908508 BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS L T P C
3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the basic concepts of brain computer interface.
- Study the various signal acquisition methods.
- Learn about the signal processing methods used in BCI.
- Understand the various machine learning methods of BCI.
- Learn the various applications of BCI.

UNIT – I: INTRODUCTION TO BCI 9

Introduction - Brain structure and function, Brain Computer Interface Types - Synchronous and Asynchronous -Invasive BCI -Partially Invasive BCI - Non Invasive BCI, Structure of BCI System, BCI Monitoring Hardware, EEG, ECoG, MEG, fMRI.

UNIT – II: BRAIN ACTIVATION 9

Brain activation patterns - Spikes, Oscillatory potential and ERD, Slow cortical potentials, Movement related potentials-Mu rhythms, motor imagery, Stimulus related potentials - Visual Evoked Potentials – P300 and Auditory Evoked Potentials, Potentials related to cognitive tasks.

UNIT – III: FEATURE EXTRACTION METHODS 9

Data Processing – Spike sorting, Frequency domain analysis, Wavelet analysis, Time domain analysis, Spatial filtering -Principal Component Analysis (PCA), Independent Component Analysis (ICA), Artefacts reduction, Feature Extraction - Phase synchronization and coherence.

UNIT- IV: MACHINE LEARNING METHODS FOR BCI 9

Classification techniques –Binary classification, Ensemble classification, Multiclass Classification, Evaluation of classification performance, Regression - Linear, Polynomial, RBF‘s, Perceptron‘s, Multilayer neural networks, Support vector machine, Graph theoretical functional connectivity analysis .

UNIT – V: APPLICATIONS OF BCI 9

Case Studies - Invasive BCIs: decoding and tracking arm (hand) position, controlling prosthetic devices such as orthotic hands, Cursor and robotic control using multi electrode array implant,Cortical control of muscles via functional electrical stimulation. Noninvasive BCIs:P300 Mind Speller, Visual cognitive BCI, Emotion detection. Ethics of Brain Computer Interfacing.

TOTAL PERIODS: 45

OUTCOMES:

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

- Comprehend and appreciate the significance and role of this course in the present contemporary world.
- Evaluate concept of BCI.
- Assign functions appropriately to the human and to the machine.
- Select appropriate feature extraction methods.
- Use machine learning algorithms for translation.

TEXT BOOKS:

1. Rajesh.P.N.Rao, ―Brain-Computer Interfacing: An Introduction‖, Cambridge University Press, First edition, 2013.
2. Jonathan Wolpaw, Elizabeth Winter Wolpaw, ―Brain Computer Interfaces: Principles and practice‖, Oxford University Press, USA, Edition 1, January 2012.

REFERENCES:

1. Ella Hassianien, A &Azar.A.T (Editors), ―Brain-Computer Interfaces Current Trends and Applications‖, Springer, 2015.
2. Bernhard Graimann, Brendan Allison, GertPfurtscheller, "Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction", Springer, 2010.
3. Ali Bashashati, MehrdadFatourechi, Rabab K Ward, Gary E Birch,‖ A survey of signal Processing algorithms in brain–computer interfaces based on electrical brain signals‖ Journal of Neural Engineering, Vol.4, 2007, PP.32-57.
4. Arnon Kohen, ―Biomedical Signal Processing‖, Vol I and II, CRC Press Inc, Boca Rato, Florida.

5. Bishop C.M., ―Neural networks for Pattern Recognition‖, Oxford, Clarendon Press, 1995.
6. Andrew Webb, ―Statistical Pattern Recognition‖, Wiley International, Second Edition, 2002.

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

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

1908509 VIRTUAL REALITY AND AUGMENTED REALITY

L	T	P	C
3	0	0	3

OBJECTIVES:

The student should be made:

- To introduce the relevance of this course to the existing technology through demonstrations,case studies and applications with a futuristic vision along with socio-economic impact and issues
- To understand virtual reality, augmented reality and using them to build Biomedical engineering applications
- To know the intricacies of these platform to develop PDA applications with better optimality
- Identify problem statements and function as a member of an engineering design team. Utilize technical resources
- To propose technical documents and give technical oral presentations related to design mini project results.

UNIT – I: INTRODUCTION 9

The three I's of virtual reality-commercial VR technology and the five classic components of a VR system - Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

UNIT – II: VR DEVELOPMENT PROCESS 9

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNIT – III: CONTENT CREATION CONSIDERATIONS FOR VR 9

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system- cyber sickness -side effects of exposures to virtual reality environment.

UNIT – IV: VR ON THE WEB & VR ON THE MOBILE 9

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-

Frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics.

UNIT – V: APPLICATIONS 9

Medical applications-military applications-robotics applications- Advanced Real time Tracking-other applications- games, movies, simulations, therapy.

TOTAL PERIODS: 45

OUTCOMES:

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

- Analyse a system or process to meet given specifications with realistic engineering constraints.
- Design a system or process to meet given specifications with realistic engineering constraints.
- Identify problem statements and function as a member of an engineering design team.
- Utilize technical resources.
- Propose technical documents and give technical oral presentations related to design mini project results.

TEXT BOOKS:

1. C. Burdea & Philippe Coiffet, ―Virtual Reality Technology‖, Second Edition, Gregory, John Wiley & Sons, Inc.,2008.
2. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.

REFERENCES:

1. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg & Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575.

2. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability),Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016.
3. The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything, Robert Scoble & Shel Israel, Patrick Brewster Press; 1 edition, 2016.
4. Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile, Tony Parisi, O'Reilly Media; 1 edition, 2015.
5. Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages, Tony Parisi, O'Reilly Media; 1 edition, 2014.
6. Learning Three.js: The JavaScript 3D Library for WebGL - Second Edition, Jos Dirksen, Packt Publishing - ebooks Account; 2nd Revised ed. Edition 2015.

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

SEMESTER VI

PROFESSIONAL ELECTIVE III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1903612	Disaster Management	PE	3	3	0	0	3
2.	1915002	Principles of Management	PE	3	3	0	0	3
3.	1904609	Soft Computing	PE	3	3	0	0	3
4.	1920001	Fundamentals of Nano Science	PE	3	3	0	0	3
5.	1904606	Intellectual Property Rights	PE	3	3	0	0	3

1903612 **DISASTER MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES:

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

UNIT- I: INTRODUCTION TO DISASTERS 9

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

UNIT- II: APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

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

UNIT- III: INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT
9

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

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

UNIT-IV: DISASTER RISK MANAGEMENT IN INDIA 9

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

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

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

TOTAL PERIODS: 45

OUTCOMES:

The students will be able to

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

TEXT BOOKS:

1. Singhal J.P. “Disaster Management”, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13:978-9380386423.
2. Tushar Bhattacharya, “Disaster Science and Management”, McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13:978-1259007361.
3. Gupta Anil K, Sreeja S. Nair. "Environmental Knowledge for Disaster Risk Management", NIDM, New Delhi, 2011.

REFERENCE BOOKS:

1. Govt. of India, Disaster Management Act , Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009.
3. Kapur Anu Vulnerable India "A Geographical Study of Disasters, IIAS and Sage Publishers", New Delhi, 2010.

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

1915002 **PRINCIPLES OF MANAGEMENT** **L T 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 PERIODS: 45

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.

REFERENCES:

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	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-
CO5	-	-	1		1	-	1	-	-	-	1	-	-	-	-	-

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, 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 PERIODS: 45

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.

REFERENCES:

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.

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	2	-	-	-	-	-	2	-	-	-	-	-	2	-	-	-
CO2	-	-	2	-	-	2	2	-	-	-	-	-	-	1	-	-
CO3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-
CO4	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	2
CO5	-	-	-	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 PERIODS: 45

OUTCOMES

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

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

1904606 **INTELLECTUAL PROPERTY RIGHTS** **L T P C**

3 0 0 3

OBJECTIVE:

- To acquaint the students with basics of intellectual property rights with special reference to Indian Laws and its practices.
- To provide an overview of the statutory, procedural, and case law underlining these processes and their interplay with litigation.
- To provide an detailed idea about Agreements and Registration.
- To provide a superior environment to students for commercialization of intellectual property.
- To encourage and protect innovation in the form of intellectual property rights.

UNIT - I: INTRODUCTION 9

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

UNIT – II: REGISTRATION OF IPRs 9

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

UNIT - III: AGREEMENTS AND LEGISLATIONS 9

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

UNIT – IV: DIGITAL PRODUCTS AND LAW 9

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

UNIT – V: ENFORCEMENT OF IPRs 9

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

TOTAL PERIODS: 45

OUTCOME:

- Skill to understand the concept of intellectual property rights.
- Develops procedural knowledge to Legal System and solving the problem relating to Intellectual property rights.
- Skill to pursue the professional programs in Company Secretary ship, Law. Business (MBA), International Affairs, Public Administration and Other fields.
- Employability as the Compliance Officer, Public Relation Officer and Liaison Officer.
- Establishment of Legal Consultancy and service provider.

TEXT BOOKS:

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

REFERENCES:

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

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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

SEMESTER VII

PROFESSIONAL ELECTIVE IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	1906008	Embedded and Real Time Systems	PE	3	3	0	0	3
2	1904006	Artificial Intelligence	PE	3	3	0	0	3
3	1915007	Hospital Waste Management	PE	3	3	0	0	3
4	1904012	Machine Learning	PE	3	3	0	0	3
5	1907003	Process Modelling and Simulation	PE	3	3	0	0	3

1906008 **EMBEDDED AND REAL TIME SYSTEMS** **L T P C**

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 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.

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

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	Programme Outcomes (PO)												Program Specific			
	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

1915007 HOSPITAL WASTE MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To understand the fundamentals of healthcare hazard control and accidents.
- To understand the concepts and the management of bio medical waste in hospitals.
- To impart knowledge on managing and handling hazardous materials in hospitals.
- Learn the facility guidelines and facility safety.
- To educate students on the safety aspects in hospital administration.

UNIT – I: HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS 9

Healthcare Hazard Control: Introduction, Hazard Control: Management & Responsibilities, Hazard Analysis, Hazard Correction, Personal Protective Equipment, Hazard Control Committees, Accident Causation Theories, Accident Reporting, Accident Investigations, Accident Analysis, Accident Prevention, Workers‟ Compensation, Orientation, Education, and Training.

UNIT – II: BIOMEDICAL WASTE MANAGEMENT 9

Biomedical Waste Management: Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling and disposal.

UNIT – III: HAZARDOUS MATERIALS 9

Hazardous Materials: Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Respiratory Protection.

UNIT – IV: FACILITY SAFETY 9

Introduction, Facility Guidelines: Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Tool Safety, Electrical Safety, Control of Hazardous Energy, Landscape and Ground Maintenance, Fleet and

Vehicle Safety.

UNIT – V: SAFETY ASPECTS IN HOSPITALS 9

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilant, and Antiseptics, OSHA Blood borne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Healthcare-Associated Infections, Medication Safety.

TOTAL PERIODS: 45

OUTCOMES:

- After successful completion of the course, the students will be able to know the concepts of healthcare, waste management and hazard control.
- Students will be able to demonstrate understanding on treatment of biomedical waste and its management.
- Students will be able to apply principles of safety in handling hazardous materials.
- Students will be able to plan and implement facility safety process and procedures.
- Show an overall understanding on safety aspects in a hospital environment.

REFERENCES:

1. Tweedy, James T., Healthcare hazard control and safety management-CRC Press Taylor and Francis, 3rd edition (2014).
2. Anantpreet Singh, Sukhjit Kaur, Biomedical Waste Disposal, Jaypee Brothers Medical Publishers (P) Ltd, 1st edition (2012).

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

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 - Linear Separability & 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).

TOTAL PERIODS: 45

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 BOOKS:

1. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

REFERENCES:

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

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 PERIODS: 45

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“, Second Edition,, Butterworths Publishers, New York, 2000.
2. Luyben, W.L., “ Process Modelling Simulation and Control “, Second Edition, 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, ”Chemical Process Modelling and Computer Simulation” Second Edition, PHI Learning Ltd, 2012.

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

SEMESTER VIII

PROFESSIONAL ELECTIVE V

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1910801	Medical Informatics	PE	3	3	0	0	3
2.	1910802	Fundamentals of Nutrition	PE	3	3	0	0	3
3.	1910803	Biometric Systems	PE	3	3	0	0	3
4.	1910804	Fiber Optics and Lasers in Medicine	PE	3	3	0	0	3

1910801 **MEDICAL INFORMATICS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To enable the student to understand the basic Hospital and Health informatics systems.
- To enhance the student knowledge Medical Data Storage and Automations.
- .To augment the student knowledge in the area of Medical Standards and Computerised Patient Record.
- To introduce the concepts of Health Informatics in Medical Science.
- To understand the fundamental concepts of Recent Trends in Medical Informatics and its application.

UNIT - I: INTRODUCTION TO MEDICAL INFORMATICS 9

Introduction - Medical Informatics – Structure of Medical Informatics- Computer based medical information retrieval, Functional capabilities of a computerized Hospital Information System, Health Informatics – Medical Informatics, Bioinformatics, Clinical informatics, Nursing informatics, Public health informatics.

UNIT - II: MEDICAL DATA STORAGE AND AUTOMATION 9

Representation of health Data, Relational, Hierarchical and network Approach, Data modeling for patient database development. Automated clinical laboratories-Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT - III: MEDICAL STANDARDS AND COMPUTERISED PATIENT RECORD 9

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA. Computer based Patient Records-History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, CPR in Radiology, Clinical information system, Computerized prescriptions for patients.

UNIT - IV: HEALTH INFORMATICS 9

Bioinformatics Databases, Bio-information technologies, Genome Analysis, Semantic web and Bioinformatics, Genome projects. Clinical information system, data for decision making, Medical diagnostic and decision support systems, Decision analysis in health informatics.

UNIT - V: RECENT TRENDS IN MEDICAL INFORMATICS 9

Virtual reality applications in medicine, Computer assisted surgical techniques-Virtual endoscopy, Computer assisted surgery, surgical simulation. Computer assisted medical education, Computer assisted patient education and health. Telemedicine, virtual Hospitals - Smart Medical Homes – Personalized e-health services.

TOTAL PERIODS: 45

OUTCOMES:

Students should be able to:

- Discuss the structure of medical Informatics and functional capabilities of Hospital Information System.
- Describe the need of computers in medical imaging and Health data storage in clinical laboratory.
- Analyze medical standards and computerized patient record in hospitals.
- Examine the medical standards.
- Identify recent trends and different ICT applications in medical Informatics.

TEXT BOOKS:

1. Mohan Bansal, Medical informatics, Tata McGraw Hill Publishing Ltd, 2013.
2. R. D. Lele, Computers in medicine progress in medical informatics, Tata McGraw Hill, 2015.

REFERENCE BOOKS:

1. Alain Venot, Anita Burgun, Catherine Quantin, “Medical Informatics, e-Health: Fundamentals and Applications”, Springer Science & Business Media, 2013.

2. Edward H. Shortliffe, James J. Cimino, “Biomedical Informatics: Computer Applications in Health Care and Biomedicine”, Springer Science & Business Media, 2013.
3. Orpita Bosu and Simminder Kaur Thukral, “Bioinformatics Databases, Tools and Algorithms”, Oxford University press, 2015.
4. Shui Qing Ye, Bioinformatics: A Practical Approach, CRC Press, 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	-	-	2	-	3	1	-	-	2	-	-	2	-	2	-
CO2	3	3	2	-	-	2	-	2	2	3	-	2	3	2	2	-
CO3	2	2	-	-	-	-	-	2	-	-	-	2	2	-	2	-
CO4	3	3	2	3	-	3	1	-	2	2	-	2	3	3	1	-
CO5	3	2	1	-	-	-	2	2	-	-	-	2	2	-	2	-

1910802 **FUNDAMENTALS OF NUTRITION** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To develop the knowledge of students in the basic area of Food Chemistry.
- For effective understanding of food processing and technology subjects.
- To introduce the concepts of blood glucose, health effects of fiber and sugar regulation.
- To enhance the student knowledge of Proteins, Food sources and Deficiency.
- To enable students to appreciate the similarities and complexities of the chemical components in foods.

UNIT - I: OVERVIEW OF NUTRITION 9

Definition, six classes of nutrients, calculating energy values from food, using the RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations, Balanced diet planning: Diet planning principles, dietary guidelines; food groups, exchange lists, personal diet analysis.

UNIT - II: DIGESTION 9

Digestion, Absorption and Transport: Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.

UNIT - III: CARBOHYDRATES 9

Glycemic and Non-glycemic carbohydrates, blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, Artificial sweeteners; Importance of blood sugar regulation, Dietary recommendations for NIDDM and IDDM.

UNIT - IV: PROTEINS & LIPIDS 9

Proteins; Food enzymes; Texturized proteins; Food sources, functional role and uses in foods. Review of structure, composition & nomenclature of fats. Non-glyceride components in fats & oils; Fat replacements; Food sources, functional role and uses in foods. Health effects and recommended intakes of lipids. Recommended intakes of proteins, Deficiency- short term and long term effects.

UNIT - V: METABOLISM, ENERGY BALANCE AND BODY COMPOSITION 9

Energy Balance; body weight and body composition; health implications; obesity, BMR and BMI calculations; Weight Control: Fat cell development; hunger, satiety and satiation; dangers of unsafe weight loss schemes; treatment of obesity; attitudes and behaviours toward weight control. Food and Pharmaceutical grades; toxicities, deficiencies, factors affecting bioavailability, Stability under food processing conditions.

TOTALPERIODS: 45

OUTCOMES:

Students should be able to:

- Discuss the overview of nutrition, Balanced diet and food groups.
- Describe the need of computers in medical imaging and Health data storage in clinical laboratory.
- Analyze medical standards and computerized patient record in hospitals.
- Examine the medical standards.
- Identify recent trends and different ICT applications in medical Informatics.

TEXT BOOKS:

1. Chopra, H.K. and P.S. Panesar, “Food Chemistry”, Narosa Publishing House, Fifth Edition,2015.
2. Vaclavik, V. A. and Christian E. W, “Essentials of Food Science”, Fourth Edition, Kluwer- Academic, Springer, 2014.
3. Mann, Jim and Stewart Truswell, “Essentials of Human Nutrition”, Third Edition, Oxford University Press, 2017.
4. Gibney, Michael J., et al., “Introduction to Human Nutrition”, Second Edition, Blackwel, 2019.
5. Gropper, Sareen S. and Jack L. Smit, “Advanced Nutrition and Human Metabolism”, Fifth Edition. Wadsworth Publishing, 2018.

REFERENCE BOOKS:

1. Gopalan C, Rama Sastri B.V, and Balasubramanian S. C, “Nutritive Value of Indian Foods”. NIN, ICMR, 2014.

2. Damodaran S, Parkin K.L and Fennema O.R, “Fennema’s Food Chemistry”. Fourth Edition, CRC Press, 2018.
3. Belitz H.D, Grosch W and Schieberle P, “Food Chemistry”, Third Revised. Edition, Springer- Verlag, 2014.
4. Walstra, P, “Physical Chemistry of Foods”, Marcel Dekker Inc. 2013.
5. Owusu-Apenten, Richard, “Introduction to Food Chemistry”, CRC Press, 2015.

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

1910803 **BIOMETRIC SYSTEMS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the technologies of fingerprint, iris, face and speech recognition.
- To explore the general principles of design of biometric systems and the underlying Trade-offs.
- To recognize personal privacy and security implications of biometrics based identification technology.
- To examine the technologies of Voice Scan, Speaker Recognition and Biometric System Integration.
- To identify issues in the realistic evaluation of biometrics based systems.

UNIT - I: INTRODUCTION TO BIOMETRICS 9

Introduction and back ground – biometric technologies – passive biometrics – active biometrics - Biometrics Vs traditional techniques – Benefits of biometrics - Operation of a biometric system– Key biometric processes: verification, identification and biometric matching – Performance measures in biometric systems: FAR, FRR, FTE rate, FTA rate and rate- Need for strong authentication – Protecting privacy and biometrics and policy – Biometric applications.

UNIT - II: FINGERPRINT IDENTIFICATION TECHNOLOGY 9

Fingerprint Patterns, Fingerprint Features, Fingerprint Image, width between two ridges - Fingerprint Image Processing - Minutiae Determination - Fingerprint Matching: Fingerprint Classification, Matching policies.

UNIT - III: FACE RECOGNITION 9

Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition, Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition.

UNIT - IV: VOICE SCAN **9**

Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration.

UNIT - V: FUSION IN BIOMETRICS **9**

Introduction to Multibiometric - Information Fusion in Biometrics - Issues in Designing a Multibiometric System - Sources of Multiple Evidence - Levels of Fusion in Biometrics - Sensor level , Feature level, Rank level, Decision level fusion - Score level Fusion. Examples – biopotential and gait based biometric systems.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Demonstrate the engineering principles underlying biometric systems.
- Analyze and design the basic biometric system applications.
- Choose appropriate face recognition techniques for Kernel- based Methods and 3D Models of Strengths and Weaknesses.
- Apply appropriate voice scan techniques and Voice Scan Strengths and Weaknesses.
- Interpret appropriate Fusion in Biometrics estimation techniques for Feature level, Rank level, Decision level fusion.

TEXT BOOKS:

1. James Wayman, Anil Jain, Davide Maltoni, Dario Maio, “Biometric Systems, Technology Design and Performance Evaluation”, Springer, Indian Reprint - 2015.
2. David D. Zhang, “Automated Biometrics: Technologies and Systems”, Kluwer Academic Publishers, New Delhi, 2016.
3. Arun A. Ross, Karthik Nandakumar, A. K. Jain, “Handbook of Multibiometrics”, Springer, New Delhi, 2013.

REFERENCE BOOKS:

1. Paul Reid, “Biometrics for Network Security”, Pearson Education, 2014.

2. Nalini K Ratha, Ruud Bolle, “Automatic fingerprint Recognition System”, Springer, 2016.
3. L C Jain, I Hayashi, S B Lee, U Halici, “Intelligent Biometric Techniques in Fingerprint and Face Recognition”, CRC Press, 2010.
4. S.Y. Kung, S.H. Lin, M. W. Mak, “Biometric Authentication: A Machine Learning Approach”, Prentice Hall, 2015.

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

1910804 FIBER OPTICS AND LASERS IN MEDICINE L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To enable the student to understand the basic optical properties of the tissues.
- To explain the optical properties of the tissues and the applications of laser in diagnosis and therapy.
- To familiarize about fiber optic lasers and applications.
- To enhance the student knowledge in the area of Holographic interferometry and application.
- To gain knowledge of instrumentation in photonics.

UNIT - I: OPTICAL PROPERTIES OF THE TISSUES 9

Refraction, Scattering, Absorption, Light transport inside the tissue, Tissue properties, Light interaction with tissues, optothermal interaction, fluorescence, speckles-Laser Characteristics as applied to medicine and biology-Laser tissue Interaction-Chemical-Thermal-Electromechanical – Photoabalative processes.

UNIT - II: OPTICAL FIBRES AND THEIR PROPERTIES 9

Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicers – Fibre termination – Optical sources – Optical detectors - Fibre optic bio-sensors and instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes.

UNIT - III: CLINICAL APPLICATIONS OF FIBER OPTIC LASER SYSTEMS 9

Properties and types of Laser, Clinical applications of laser, Fiber optic Laser system in - cardiovascular disease, Gastroenterology, general and thoracic surgery, Neurosurgery, Oncology, Opthalmology, Orthopedics, Otolaryngology, Urology.

UNIT - IV: INSTRUMENTATION IN PHOTONICS 9

Instrumentation for absorption, Scattering and emission measurements, excitation light sources – high pressure arc lamp, LEDs, Lasers, Optical filters, - optical detectors – Time resolved and phase resolved detectors.

UNIT - V: HOLOGRAM AND MEDICAL APPLICATIONS 9

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

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Discuss the properties of optics fibers and relate with tissues.
- Describe the need of computers in medical Scattering and emission measurements.
- Explain the clinical application of fiber optic lasers.
- Analyze the Holographic interferometry, applications and testing of hologram components.
- Examine the fiber optic techniques with medical applications.

TEXT BOOKS:

1. Paras N. Prasad, "Introduction to Biophotonics", A. John Wiley and Sons, Inc. Publications, 2013
2. Abraham Katzir, "Lasers and Optical Fibers in Medicine", Academic press Inc.

REFERENCE BOOKS:

1. John Crisp, "Introduction to fiber optics", 2nd Edition, Newnes, 2018,
2. Markolf H. Niemz, "Laser-Tissue Interaction Fundamentals and Applications", Springer, Indian Reprint-2017.
3. J.M. Senior, Optical Fibre Communication – Principles and Practice, Prentice Hall of India,1985.

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

SEMESTER VIII

PROFESSIONAL ELECTIVE VI

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1910805	Neural Networks and its Applications	PE	3	3	0	0	3
2.	1910806	Bio signal Processing	PE	3	3	0	0	3
3.	1910807	Medical Expert Systems	PE	3	3	0	0	3
4.	1910808	Telehealth Technology	PE	3	3	0	0	3
5.	1910809	Wearable Systems	PE	3	3	0	0	3

1910805 **NEURAL NETWORKS AND ITS APPLICATIONS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- Understand the basic neural network architectures and learning algorithms.
- Enhance the student knowledge in the area of applications in pattern recognition, image processing and computer vision.
- Explore the use of Pattern and Neural Classifiers for classification applications.
- Introduce neural computing as an alternative knowledge acquisition/ representation paradigm.
- Gain knowledge of neural networks.

UNIT - I: FROM BIOLOGY TO ARTIFICIAL NEURAL NETWORKS – INTRODUCTION **9**

Brief History of Neural Networks, Biological Neural Networks, Components of Artificial Neural Networks – Connections, Propagation function and Network Inputs, Common Activation Functions, Threshold, Network Topologies, Bias Neuron, Fundamentals of Learning and Training – Supervised, Unsupervised, Reinforcement, Training Pattern and Teaching Input, Learning Curve and Error measurement.

UNIT - II: SUPERVISED NETWORK LEARNING PARADIGMS **9**

Perceptron and back propagation – Single Layer Perceptron, Convergence theorem, delta rule, Linear Separability, Multilayer Perceptron, Back propagation of error, variation and extension to backpropagation. Recurrent perceptron like networks.

UNIT - III: ASSOCIATIVE NETWORK AND NETWORK BASED ON COMPETITION **9**

Evolution of Medical Standards – IEEE 11073 - HL7 – DICOM – IRMA - LOINC – HIPPA. Computer based Patient Records-History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, CPR in Radiology, Clinical information system, Computerized prescriptions for patients.

UNIT - IV: OTHER ADVANCE NEURAL NETWORKS 9

Radial Basis Functions, Support Vector Machines, Extreme Learning Machine, Extended Extreme Learning Machine, Principle component Analysis, Deep Learning and Hierarchical Temporal Memory.

UNIT - V: APPLICATION OF NEURAL NETWORKS 9

ANN in Computer-Aided Diagnosis, ANN as multivariate statistical model, ANN for medical Image segmentation, ANN as a predictive model, ANN as an optimizer.

TOTALPERIODS: 45

OUTCOMES:

The student should be able to:

- Examine the neural network architecture and learning algorithms.
- Implement Pattern and Neural Classifiers for various classification applications.
- Analyze the Radial Functions, Vector Machines and Deep Learning.
- Explain the neural networks of application ANN.
- Describe the need of artificial neural networks.

TEXT BOOKS:

1. David Kriesel, "A Brief Introduction to neural networks", (ZETA2-EN), Second edition, Publisher: Zeta, 2013. (http://www.dkriesel.com/en/science/ neural networks Zeta 2 edition)
2. Laurene Fausett, "Fundamentals of neural networks- Architectures, algorithms and applications", First Edition, Prentice Hall, 2014.

REFERENCE BOOKS:

1. James A Freeman and David M.Skapra, "Neural Networks: Algorithms, Applications, and Programming Techniques", Addison-Wesley, 1991, Digital Version, 2017.
2. Simon O. Haykins, "Neural Networks: A Comprehensive Foundation", second Edition, Pearson, 2015.
3. Edited by Kenji Suzuki, "Artificial Neural Networks - Methodological Advances and Biomedical Applications", ISBN 978-953-307-243-2, 374 pages, Publisher: InTech, 2011.

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

1910806 **BIO SIGNAL PROCESSING** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the characteristics of some of the most commonly used biomedical signals, including ECG, EEG, EOG, and EMG.
- To identify the choice of filters to remove noise and artifacts from biomedical signals.
- To explore established engineering methods to analyse ECG signal problems.
- To apply established engineering methods to analyse neurological signals.
- To analyse various biomedical signals through advanced techniques.

UNIT - I: INTRODUCTION TO BIOMEDICAL SIGNALS 9

Bio signal Characteristics of Electro Cardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Electrogastrogram (EGG), Electroneurogram (ENG), Event related potentials (ERPs), Phonocardiogram (PCG), Speech signal, Objectives of Biomedical signal analysis, Difficulties in Biomedical signal analysis, Computer-aided diagnosis.

UNIT - II: FILTERING FOR REMOVAL OF ARTIFACTS 9

Time-domain Filters - synchronized averaging, Moving Average Filters, Derivative-based operators to remove low-frequency artifacts. Frequency-domain filters - Removal of High Frequency noise, Removal of low frequency noise, Removal of periodic artifacts, optimal filter- Wiener filter, Adaptive filters for removal of interference.

UNIT - III: CARDIOVASCULAR APPLICATIONS 9

Noise & Artifacts, ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection, Adaptive noise canceling in ECG, improved adaptive filtering in FECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets. Computation of diagnostic signal parameters of ECG, like Heart rate and QRS detection, using Multivariate analysis (PCA and ICA). Segmentation of PCG, intensity patterns, Spectral modeling and analysis of PCG signals.

UNIT - IV: NEUROLOGICAL APPLICATIONS 9

EEG rhythms & waveforms, EEG applications- Epilepsy, sleep disorders, brain computer interface. Modeling EEG- linear, stochastic models - Nonlinear modeling of EEG - artifacts in EEG & their characteristics and processing – Nonparametric spectral analysis, Model based spectral analysis - EEG segmentation - Joint Time-Frequency analysis - correlation analysis of EEG channels - coherence analysis of EEG channels. Evoked potentials- noise characteristics, Noise reduction by linear filtering.

UNIT - V: ANALYSIS ON WAVESHAPE, SIGNAL CLASSIFICATION AND RECOGNITION 9

Modeling intramuscular EMG- Intramuscular signal decomposition-Fractal analysis of EMG signals. Statistical analysis of VAG signals. Analysis on amplitude and latency of MEG signals. Analysis of ERP effect, Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network-based classification. Analysis of EEG using Empirical mode decomposition (EMD).

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Draw different types of biomedical signals and identify their spectral components.
- Use different filters on biomedical signals and judge filter performance.
- Understand the physiological interferences and artifacts affecting ECG signal.
- Compute signal parameters of ECG signals.
- Propose an algorithm to classify biomedical signals.

TEXT BOOKS:

1. Rangayyan, “Biomedical Signal Analysis”, Second Edition, Wiley, 2016.
2. Semmlow, “Bio signal and Biomedical Image Processing”, Third Edition, Marcel Dekker, 2004.

REFERENCE BOOKS:

1. Sornmo, “Bioelectrical Signal Processing in Cardiac & Neurological Applications”, First Edition, Elsevier, 2005.

2. D.C.Reddy, “Biomedical Signal Processing: Principles and techniques”, First Edition, Tata McGraw Hill, 2005.
3. Bruce, “Biomedical Signal Processing & Signal Modeling”, First Edition, Wiley, 2001.
4. Arnon Cohen, “Bio-Medical Signal Processing Vol. I and Vol. II”, First Edition, CRC Press Inc., Boca Rato, Florida 1999.
5. Willis J Tompkins, “Biomedical Digital Signal Processing”, Second Edition, Prentice Hall, 1993.

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

1910807 **MEDICAL EXPERT SYSTEMS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To develop informed opinions about the present and past opinion leaders in the artificial intelligence debate.
- To identify a simple, informal expert system by performing an effort of knowledge engineering of a real, human expert.
- To apply, build and modify decision models to solve real problems.
- To create a series of Web pages that will serve as a current "state of the art" review of the various AI application areas, areas which may be suggested by the instructor or brought to the course by participants.
- To experience some actual hands-on demonstration software while accomplishing the review of current applications areas in AI.

UNIT - I: INTRODUCTION TO AI 9

Definition of AI – importance of AI – problem solving, searching, heuristic searching.

UNIT- II: KNOWLEDGE REPRESENTATION 9

Preposition Logic – Clause form – Predicate logic – Resolution – Inference Rules – Unification – Semantic networks – frames – conceptual dependency – Scripts – knowledge representation using rules – rule-based systems.

UNIT - III: EXPERT SYSTEMS 9

Expert system architecture - non-production systems architecture– knowledge acquisition and validation - Knowledge system building tools.

UNIT - IV: LEARNING & DECISION MAKING 9

Types of learning – general learning model – learning by induction – generalization & specialization – inductive bios – explanation-based learning.

UNIT - V: CASE STUDY 9

Study of medical expert systems – MYCIN, EMYCIN - development of medical expert systems – sample Case studies.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Understand the importance of Artificial Intelligence and expert systems.
- Apply, build and modify decision models to solve real problems.
- Design and develop Artificial Intelligence Based Decision Support Systems.
- Discuss the role of expert systems in the business environment.
- Build a prototype Artificial Intelligence Based Decision Support System.

TEXT BOOKS:

1. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, First Edition, Prentice Hall of India, Delhi, 2001.
2. Watterman, “A Guide to Expert Systems”, First Edition, McGraw Hill, New York, 1991.

REFERENCE BOOKS:

1. George F Luger, “Artificial Intelligence, structures and strategies for complex problem solving”, Fifth Edition, Pearson Education Delhi, 2001.
2. Elain Rich and Kevin Knight, “Artificial Intelligence”, Second Edition, Tata McGraw Hill, 1993.
3. R.D.Lele, “Computers in Medicine”, Second Edition, Tata McGraw Hill, New Delhi-1989.

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

1910808 TELEHEALTH TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To learn the key principles for telemedicine and health.
- To understand technology infrastructure required to provide telehealth options for care.
- To compare patient experiences and feelings about the utilization of telehealth for both primary and secondary access to care.
- To understand telemedical technology.
- To know telemedical standards, mobile telemedicine and it applications.

UNIT- I: FUNDAMENTALS OF TELEMEDICINE 9

History of telemedicine, definition of telemedicine, tele-health, tele-care, scope, Telemedicine Systems, benefits & limitations of telemedicine.

UNIT- II: TYPE OF INFORMATION & COMMUNICATION INFRASTRUCTURE FOR TELEMEDICINE 9

Audio, video, still images, text and data, fax-type of communications and network: PSTN, POTS, ANT, ISDN, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT- III: ETHICAL AND LEGAL ASPECTS OF TELEMEDICINE 9

Confidentiality, patient rights and consent: confidentiality and the law, the patient-doctor relationship, access to medical records, consent treatment - data protection & security, jurisdictional issues, intellectual property rights.

UNIT - IV: PICTURE ARCHIVING AND COMMUNICATION SYSTEM 9

Introduction to radiology information system and ACS, DICOM, PACS strategic plan and needs assessment, technical Issues, PACS architecture.

UNIT- V: APPLICATIONS OF TELEMEDICINE 9

Teleradiology, telepathology, telecardiology, tele oncology, tele dermatology, telesurgery, e Health and Cyber Medicine.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Understand the Picture archiving techniques and technical issues.
- Apply multimedia technologies in telemedicine.
- Understand the benefits & limitation of telemedicine.
- Learn the Ethical and Legal aspects in telemedicine.
- Aspire the knowledge in various applications of telemedicine in health care sector.

TEXT BOOKS:

1. H K Huang, "PACS and Imaging Informatics: Basic Principles and Applications", Second Edition, Wiley, New Jersey, 2010.
2. Norris A C, - "Essentials of Telemedicine and Telecare", First Edition, John Wiley, New York, 2008.

REFERENCE BOOKS:

1. Khandpur R S, "TELEMEDICINE - Technology and Applications", First Edition, PHI Learning Pvt Ltd., New Delhi, 2017.
2. Khandpur R S, "Handbook of Biomedical Instrumentation", Second Edition, Tata McGraw Hill, New Delhi, 2003.
3. Olga Ferrer Roca, Marcelo Sosa Iudicissa, "Handbook of Telemedicine", First Edition, IOS Press, Netherland, 2002.
4. Keith J Dreyer, Amit Mehta, James H Thrall, "Pacs: A Guide to the Digital Revolution", Second Edition, Springer, New York, 2002.

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

1910809 **WEARABLE SYSTEMS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To study about sensors and its application in wearable systems.
- To know about Sensor design and signal acquisition.
- To gain knowledge in energy harvesting methods for wearable systems.
- To understand the need for wireless technology in wearable systems.
- To learn about applications of wearable systems.

UNIT - I: SENSORS 9

Need for wearable systems, Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor, GSR, Radiant thermal sensor, Wearable motion sensors, CMOS –Based Biosensors, E-Textiles, Bio compatibility.

UNIT- II: SIGNAL PROCESSING 9

Wearability issues -physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, Constraint on sampling frequency for reduced energy consumption, light weight signal processing, Rejection of irrelevant information, Data mining.

UNIT- III: ENERGY HARVESTING FOR WEARABLE DEVICES 9

Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT- IV: WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Definition of Body area network, BAN and Healthcare, Technical Challenges- System security and reliability, BAN Architecture – Introduction, Wireless communication techniques.

UNIT - V: APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, Multi parameter monitoring, Neural recording, Gait analysis, Sports Medicine, Smart Fabrics.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Explain need of wireless health systems and the application of wearable systems.
- Identify the key design criteria and suggest an appropriate wearable sensor approach which is most likely to meet a specific biosensor application.
- Apply the energy harvesting techniques in the wearable devices.
- Design wireless body area networks.
- Develop the wearable device for patient monitoring applications.

TEXT BOOKS:

1. Sandeep K.S. Gupta, Tridib Mukherjee, Krishna Kumar, Venkatasubramanian, "Body Area Networks Safety, Security, and Sustainability", First Edition, Cambridge University Press, 2013.
2. Annalisa Bonfiglio, Danilo De Rossi, "Wearable Monitoring Systems", Second Edition, Springer, 2011.

REFERENCE BOOKS:

1. Hang Yuan-Ting, "Wearable medical sensors and systems", First Edition, Springer International Publishing AG, 2017.
2. Mehmet R. Yuce, Jamil Y. Khan, "Wireless Body Area Networks Technology, Implementation and Applications", First Edition, Pan Stanford Publishing Pvt. Ltd, Singapore, 2012.
3. Guang-Zhong Yang (Ed.), "Body Sensor Networks", Second Edition", Springer, 2006.
4. Andreas Lymberis, Danilo de Rossi, "Wearable eHealth systems for Personalised Health Management - State of the art and future challenges", First Edition, IOS press, The Netherlands, 2004.

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

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 System	CSE	3	3	0	0	3
8.	1904509	Cloud Computing	CSE					
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.	1906507	Entertaintronics	ECE	3	3	0	0	3
13.	1906505	Photonic Networks	ECE	3	3	0	0	3
14.	1906506	Telecommunication Network Management	ECE	3	3	0	0	3
15.	1907503	Sensors and Transducers	EIE	3	3	0	0	3
16.	1907504	Instrumentation in Biomedical Engineering	EIE	3	3	0	0	3
17.	1908001	3D Printing and Design	IT	3	3	0	0	3
18.	1908002	Scripting Languages	IT	3	3	0	0	3
19.	1909510	Product Design and Development	MECH	3	3	0	0	3
20.	1909511	Vibration and Noise Control	MECH	3	3	0	0	3
21.	1909512	Industrial Safety Engineering	MECH	3	3	0	0	3
22.	1920501	Nanotechnology	PHYSICS	3	3	0	0	3
23.	1920502	Microscopy	PHYSICS	3	3	0	0	3
24.	1921501	Advanced Engineering Chemistry	CHEMISTRY	3	3	0	0	3
25.	1921502	Industrial Nanotechnology	CHEMISTRY	3	3	0	0	3

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 PERIODS: 45

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 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	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

1902513 PRODUCTION TECHNOLOGY OF AGRICULTURAL MACHINARY 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 members - slide ways - linear bearings - ball screws - spindle drives and feed drives. Part programming fundamentals - manual programming.

TOTAL PERIODS: 45

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 MATRIX

Course Outcomes	PROGRAM OUTCOMES												Program Specific			
	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

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 PERIODS: 45

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 MATRIX

Course Outcomes	PROGRAM OUTCOMES												Program Specific			
	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	-

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 PERIODS: 45

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.
2. Murthy, J.V.S., “Watershed Management in India”, Wiley Eastern Ltd., New York, 1995.
3. Sharma V.K. (1989): “Water Resources & Water management”, Himalaya Publishing Bombay.

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

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 Analyze data analytics and various applications of GIS.
- To understand the 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 - Types of data – 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 utilization.

UNIT – V: APPLICATIONS **9**

GIS Applicant - Natural Resource Management - Engineering - Navigation - Vehicle tracking and fleet management - Marketing and Business applications - Case studies.

TOTAL PERIODS: 45

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.
- 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.

REFERENCES:

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

1904007 DATA STRUCTURES L T P C

3 0 0 3

OBJECTIVE

- To understand Linear Data structures programs.
- To understand the Non linear 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 9

Linear Search – Binary Search - Hash tables – Overflow handling – Hash Index – B-Tree Indexing.

TOTAL PERIODS: 45

OUTCOME

- 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.

REFERENCES:

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 Education,1997.

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

1904508 **DATABASE MANAGEMENT SYSTEM** **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.

UNIT - 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 PERIODS: 45

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, Shamkant B. Navathe, —Fundamentals of Database Systems, Sixth Edition, Pearson, 2011.

REFERENCES:

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

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.

UNIT- 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

Linear Search – Binary Search - Hash tables – Overflow handling – Hash Index – B-Tree

Indexing.

TOTAL PERIODS: 45

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, 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 and Security, CRC Press, 2017.

REFERENCES:

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

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.
- Utilise 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 PERIODS: 45

COURSE OUTCOMES:

- Can able to analyse the energy data.
- Can carryout 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.

REFERENCES:

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

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.

TOTAL PERIODS: 45

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

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 PERIODS: 45

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

1906507 **ENTERTAINTRONICS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the basics of display devices.
- To enhance the student knowledge in Audio broadcasting systems.
- To enable the student to learn about Television systems.
- To develop the student knowledge in Interactive Gaming Applications.
- To apply the knowledge of Consumer Electronic Applications.

UNIT - I: DISPLAY DEVICES 9

Introduction – Underlying technologies of displays -Types of Electronic displays – Segment displays –Two dimensional displays: Liquid Crystal display, Light emitting diode display – Three dimensional displays: Laser display, Holographic display – Applications.

UNIT - II: AUDIO BROADCASTING SYSTEMS 9

Loud Speakers: construction, working principles and applications of crystal, condenser and dynamic loudspeakers – Tweeters, Squawkers & Woofers - Public address system - Requirements of Public Addressing system -Microphones: construction, working principles and applications of Carbon, Moving coil and Crystal microphones. Headphones: Principle of operation of crystal and dynamic and Bluetooth based headphones.

UNIT - III: TELEVISION SYSTEMS 9

Basics of Television: Television standards, frequency bands, Scanning method, interlacing and synchronization, bandwidth, Advanced TV systems: LCD, LED, HDTV,3DTV, Smart TV. Color concepts, concepts of luminance, Hue and Saturation, Color TV (PAL Systems). Cable TV concepts, Closed Circuit Television.

UNIT - IV: INTERACTIVE GAMING APPLICATIONS 9

Fundamental of game design - Gaming scenarios – Interfaces- Multi player interactive gaming – Programming concepts – educational games – Privacy and security in games – Introduction to Android games and its development – Online games.

UNIT - V: CONSUMER ELECTRONIC APPLICATIONS 9

Principle of operation of digital clocks, electronic calculator, cellular phones- smart phonesmicrowave ovens, washing machines, air conditioners, ATMs and set-top-boxes – Compact Ultrafast Fiber lasers for Consumer electronics – Virtual reality applications, Alexa.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Understand the basic applications of display devices.
- Analyze the operation of Audio devices and its applications.
- Know the basic TV Standards and the basics of Television.
- Design the Gaming scenarios and knowing programming concepts.
- Apply the knowledge on the applications of Consumer electronics.

TEXT BOOKS:

1. Shoichi Matsumoto, “Electronic display devices”, Wiley, 1990.
2. Ajay Sharma, “Audio video and TV Engineering-Consumer Electronics”, Dhanpat Rai and co, 2003.

REFERENCE BOOKS:

1. R. Gulati, “Monochrome and Color Television”, New Age International (P) Ltd, New Delhi, 2014.
2. S P Bali, “Consumer Electronics”, Pearson, 2007.
3. R.G. Gupta, “Audio and Video systems”, Tata Mc Graw Hill Publishing Co.Ltd, 2010.

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

1906505 **PHOTONIC NETWORKS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To enable the students to manifest the components used is the optical system, propagation of signals and their impairments in optical fiber.
- To enable the student to understand the importance of the backbone infrastructure for our present and future communication needs.
- To familiarize the students about the optical network architectures and the protocol stack in use.
- To enable the student to understand the differences in the design of data plane and the control plane and the routing, switching and the resource allocation methods and the network management and protection methods in vogue.
- To expose the student to the advances in networking and switching domains and the future trends.

UNIT - I: OPTICAL SYSTEM COMPONENTS 9

Light Propagation in optical fibers – Loss & bandwidth, System limitations, Nonlinear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT - II: OPTICAL NETWORK ARCHITECTURES 9

Introduction to Optical Networks; Wavelength Division Multiplexing, optical add/drop multiplexer, SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Wavelength Routing Architecture.

UNIT - III: WAVELENGTH ROUTING NETWORKS 9

The optical layer, Optical Network Nodes, Routing and wavelength assignment, Traffic Grooming in Optical Networks, Architectural variations- Linear Light wave networks, Logically Routed Networks.

UNIT - IV: PACKET SWITCHING AND ACCESS NETWORKS 9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronization, Broadcast OTDM networks, Switch-based networks, Contention Resolution Access Networks – Network Architecture overview, Optical Access Network Architectures and OTDM networks, OTDR.

UNIT - V: NETWORK DESIGN AND MANAGEMENT 9

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion, Wavelength stabilization, Overall design considerations, Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Elucidate the components in an optical system.
- Use the backbone infrastructure for our present and future communication needs.
- Analyze the architectures and the protocol stack.
- Compare the differences in the design of data plane, control plane, routing, switching, resource allocation methods.
- Annotate the network management and protection methods in vogue.

TEXT BOOKS:

1. Rajiv Ramaswami and Kumar N. Sivarajan, "Optical Networks: A Practical Perspective", Second Edition, Harcourt Asia Pte Ltd., 2004.
2. Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks: Concept, Design and Algorithms", 1st Edition, Prentice Hall of India, 2002.

REFERENCE BOOKS:

1. John M. Senior ,"Optical Fiber Communication",3rd edition, Prentice Hall,2009.
2. Uyless N. Black, "Optical Networks, Third Generation Transport Systems",1st Edition, Prentice hall of India, 2002.

3. Biswanath Mukherjee, “Optical WDM Networks”, Springer Series, 2006.
4. Govind P. Agrawal, “Fiber Optic Communication Systems”, 3rd Edition, Wiley India (P) Ltd, 2002.
5. Gerd Keiser , “Optical Fiber Communication” , 5th Edition , McGraw Hill Education (India) Pvt. Ltd. , 2013.

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

1906506 TELECOMMUNICATION NETWORK MANAGEMENT **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the concept of network management standards.
- To design the common management information service element model.
- To analyze the various concept of information modeling.
- To examine the concept of SNMPv1 and SNMPv2 protocol.
- To exhibit the examples of network management.

UNIT - I: BASIC FOUNDATIONS AND NETWORK MANAGEMENT APPLICATIONS 9

Network management standards–Network management model– Organization model– Information model - Abstract syntax notation One (ASN.1) – Encoding structure– Macros –Functional model. Network management applications functional requirements: Configuration management– Fault management–Performance management–Error correlation technology– Security management–Accounting management– Common management–report management– Policy based management – Service level management – Management service– Community definitions– capturing the requirements– simple and formal approaches–semi formal and formal notations.

UNIT - II: COMMON MANAGEMENT INFORMATION SERVICE ELEMENT 9

CMISE model–service definitions–errors–scooping and filtering features– synchronization–functional units– association services– common management information protocol specification.

UNIT - III: INFORMATION MODELING FOR TMN 9

Rationale for information modeling–management information model–object oriented modeling paradigm– structure of management information–managed object class definition–management information base.

UNIT - IV: SIMPLE NETWORK MANAGEMENT PROTOCOL 9

SNMPv1: Managed networks–SNMP models– organization model– Information model–

SNMPv1 communication model–functional model. SNMPv2-major changes in SNMPv2–structure of management information, MIB–SNMPv2 protocol– compatibility with SNMPv1. SNMPv3– architecture–applications–MIB- security, SNMP Management: remote monitoring–SMI and MIB– RMON1 and RMON2.

UNIT - V: NETWORK MANAGEMENT EXAMPLES 9

ATM integrated local management interface–ATM MIB–M1– M2–M3–M4–interfaces–ATM digital exchange interface management–digita1 subscriber loop and asymmetric DSL technologies–ADSL configuration management–performance management Network management tools: Network statistics management–network management system–management platform case studies: OPENVIEW–ALMAP.

TOTAL PERIODS: 45

OUTCOMES:

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

- Design and analyze of fault management.
- Analyze the common management information protocol specifications.
- Explain the functioning and design of management information model.
- Describe the simple network management protocol.
- Interpret the various types of network management tools with case studies.

TEXT BOOKS:

1. Mani Subramanian, "Network Management: Principles and Practice", Pearson Education, Second edition, 2010.
2. Lakshmi G Raman, "Fundamentals of Telecommunications Network Management", Wiley, 1999.

REFERENCE BOOKS:

1. Henry Haojin Wang, "Telecommunication Network Management", Mc- Graw Hill, 1999.
2. Salah Aidarous & Thomas Plevyak, "Telecommunication Network Management: Technologies and Implementations", Wiley, 1997.
3. Singh B, "Network Security and Management", Eastern Economy Edition, 2012.

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

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 PERIODS: 45

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

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 ELECTRODE CONFIGURATIONS 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 PERIODS: 45

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. (Units I, II & V).

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.(Units II & IV).
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

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

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 PERIODS: 45

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.
2. CK Chua, Kah Fai Leong, "3D Printing and Rapid Prototyping- Principles and Applications", World Scientific, 2017.
3. J.D. Majumdar and I. Manna, "Laser-Assisted Fabrication of Materials", Springer Series in Material Science, 2013.
4. L. Lu, J. Fuh and Y.S. Wong, "Laser-Induced Materials and Processes for Rapid
   a. Prototyping", Kulwer Academic Press, 2001.
5. Zhiqiang Fan And Frank Liou, "Numerical Modelling of the Additive Manufacturing (AM) Processes of Titanium Alloy", InTech, 2012.

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	-	2	-	-	-	-	-	-	-	-	-	-	-
CO2	2	-	-	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	2	-	-	-	-	2	-	-	-	-	-	-	-	-	2	-
CO4	-	2	3	-	-	-	-	-	-	-	-	-	-	-	2	-
CO5	-	-	-	-	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 PERIODS: 45

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

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 PERIODS: 45

COURSE OUTCOMES:

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

- Understand the product design concepts.
- 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.

TEXT BOOK:

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.

REFERENCES:

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 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	2	1	1	1	-	-	-	1	-	1	-	1	-	-	1	2
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	-	-	2

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.

TOTAL PERIODS: 45

COURSE 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 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	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	-	-

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 9

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 PERIODS: 45

COURSE 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.

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 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	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	-	-

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 nano system –Dimensionality and size dependent phenomena –Surface to volume ratio - Fraction of surface atoms-Properties at nanoscale (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 PERIODS: 45

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 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	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	-	-

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 aperture, 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 ANALYSIS 9

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 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 PERIODS: 45

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.

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	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

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.

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.

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

1921502 **INDUSTRIAL NANOTECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

- 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 nano particle coatings for electrical products.
- Define various therapeutic applications of bio nanotechnology.
- Explain the process of molecular encapsulation and nano reactors.
- 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 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	2	2	2	-	2	1	1	-	1	-	-	-	3	-	1	-
CO2	1	2	3	-	1	3	1	-	-	-	-	-		1	-	-
CO3	2	1	2	-	1	1	2	-	1	-	-	-	1	-	1	-
CO4	3	2	1	-	2	1	1	-	1	-	-	-	-	-	-	2
CO5	2	2	1	2	1	1	1	-	1	-	-	-	2	-	2	-

OPEN ELECTIVE – II (VII SEMESTER)

SL NO.	COURSE CODE	COURSE TITLE	Course offering Department	CONTACT HOURS	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.	1906705	Acoustics	ECE	3	3	0	0	3
10.	1906706	Visual Communication	ECE	3	3	0	0	3
11.	1906707	MEMS and NEMS	ECE	3	3	0	0	3
12.	1907001	Transducers Engineering	EIE	3	3	0	0	3
13.	1907003	Process Modeling and Simulation	EIE	3	3	0	0	3
14.	1907708	State Variable Analysis and Design	EIE	3	3	0	0	3
15.	1908003	Software Quality Management	IT	3	3	0	0	3
16.	1908004	C # and .Net Programming	IT	3	3	0	0	3
17.	1908005	Virtual Reality	IT	3	3	0	0	3
18.	1909718	Robotics	MECH	3	3	0	0	3
19.	1909719	Testing of Materials	MECH	3	3	0	0	3
20.	1909720	Design of Electric vehicles	MECH	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

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 Building.

UNIT- II: IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY 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.

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 PERIODS: 45

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

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 PERIODS: 45

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

1904703 **TAMIL COMPUTING** **L T P C**

3 0 0 3

COURSE 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 PERIODS: 45

COURSE OBJECTIVES

- 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.
- 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 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	-	-	-	-	-	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

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 PERIODS: 45

OUTCOMES:

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

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

TEXT BOOKS:

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

REFERENCES:

1. Paul Deitel, Harvey Deitel, ―Java SE 8 for programmers‖, 3rd Edition, Pearson, 2015.
2. Steven Holzner, ―Java 2 Black book‖, Dreamtech press, 2011.
3. Timothy Budd, ―Understanding Object-oriented programming with Java‖, Updated Edition, Pearson Education, 2000.
4. Joshua Bloch – Effective Java- 3rd Edition, Addison Wesley

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

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 PERIODS: 45

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.

REFERENCES:

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

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.

TOTAL PERIODS: 45

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 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	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	-	-	-

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).

TOTAL PERIODS: 45

COURSE OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.
- 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.

TEXTBOOKS:

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 Iinc, 1995.
5. Andrzej M. Trzynnadlowski, „Introduction to Modern Power Electronics‟, Second edition, wiley India Pvt. Ltd, 2012.

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	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	-	-	-

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 SYSTEMS 9

Battery Basics, Different types, Battery Parameters, Battery modeling, Traction Batteries, Energy management system in Electric vehicle – Battery Management Systems.

UNIT-V: ALTERNATIVE ENERGY STORAGE SYSTEMS 9

Fuel cell – Characteristics- Types – hydrogen Storage Systems and Fuel cell EV – Ultra Capacitors.

TOTAL PERIODS: 45

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.

TEXT BOOKS:

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 20
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.

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**
CO 1	3	-	1	-	2	2	2	-	-	-	1	2	-	1	-	-
CO 2	2	-	2	-	1	-	1	-	2	-	2	-	2	2	-	-
CO 3	3	2	1	-	2	-	-	-	2	-	-	-	-	3	-	1
CO 4	3	2	2	-	1	-	2	-	-	-	2	-	-	-	2	-
CO 5	3	2	1	-	1	-	-	-	1	-	2	2	2	-	-	-

1906705 **ACOUSTICS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To learn the origin of sound.
- To understand the knowledge in sound propagation.
- To enhance the concepts in Sound analysis.
- To acquire basic knowledge in Physiological acoustics.
- To enable the student to understand the analysis of acoustics.

UNIT - I: INTRODUCTION 9

Origin of sound. Objective and subjective sound. Sound vibrations, Amplitude, form, and period. Sound waves and their wavelength and speed. Sound pressure level. Energy parameters of sound. Dynamical range. Sound envelope, Sound frequency, Relation between frequency and period.

UNIT - II: PROPAGATION OF SOUND 9

Sound propagation. Spherical and plane waves. Change of intensity of a propagating sound wave. Sound reflections, echo, absorption, diffraction, refraction. Relation between pitch and frequency. Pitch standard. Sound spectrum. Types of Public Addressing system. Hi.fi speakers. Microphones: types and its applications.

UNIT - III: SOUND ANALYSIS 9

Natural scales. Origin of musical scale. Tonal material and modal scale. Pythagorean tuning, Temperaments. Non-equal temperaments. Equal temperaments. Relation of musical scale and kind of music. Sound Pre-Processing and analysis, Audio analysis tools.

UNIT - IV: PHYSIOLOGICAL ACOUSTICS 9

Physiological and psychological acoustics. Loudness. Loudness level. Fletcher-Munson diagram. Range of hearing. Masking. Compression of sound information, Pitch, timbre, subjective duration. Absolute pitch. Acoustics instruments. Peripheral auditory system.

UNIT - V: ACOUSTICAL ANALYSIS 9

Sound phenomena in rooms. Direct sound. Early reflections. Reverberation and its formation, Criteria for good acoustics of a room and methods of their realization, Reverberation time. Dependence of reverberation time on room volume and surfaces (area and absorption), Evaluation of reverberation time. Optimal reverberation times for various types of music and room sizes.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Analyze the basic parameters of sound.
- Understand the effects of propagation.
- Know the basic functions of sound analysis.
- Derive the output using Physiological acoustics.
- Acquire the knowledge on the Applications of acoustics.

TEXT BOOKS:

1. Rossing T. D., Moore R. F., Wheeler P. A.," The Science of Sound", 3rd edition San Francisco: Addison Wesley, 2002.
2. Hall D. E.," Musical Acoustics", 3rd edition Pacific Grove, CA: Brooks/Cole, 2001.
3. Howard D. M., Angus J. A. S.," Acoustics and psychoacoustics", 5th edition New York, London: Routledge, 2017.

REFERENCE BOOKS:

1. Everest F. A., Pohlmann K. C.," Master Handbook of Acoustics", 5th edition New York: McGraw-Hill, 2001.
2. Rossing T. D., ed.," Springer Handbook of Acoustics", 2nd edition Berlin, Heidelberg: SpringerVerlag 2014.
3. Chakrabarti, Pradip Kumar and Chowdhury, Satyabrata, "A Textbook on Waves and Acoustics", New Central book agency, 2010.

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
CO 1	3	-	-	-	-	2	2	-	-	-	-	-	3	-	-	-
CO 2	2	2	-	2	-	2	3	-	-	-	-	-	2	-	-	-
CO 3	2	2	2	-	-	2	3	-	-	-	-	-	2	-	-	-
CO 4	2	3	2	2	-	2	2	-	-	-	-	-	3	3	-	-
CO 5	2	2	1	2	-	2	-	2	-	-	-	-	2	-	-	-

1906706 **VISUAL COMMUNICATION** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To know about the basics of communication.
- To learn and acquire the art of visual communication.
- To understand and relate the importance of visual communication.
- To gain knowledge about the basic of Visual Communication.
- To acquire idea and concepts of various forms of Media.

UNIT - I: INTRODUCTION 9

Need for and the Importance of Human and Visual Communication. Communication a expression, skill and process, Understanding Communication: SMRC-Model.

UNIT - II: PROCESS IN COMMUNICATION 9

Communication as a process. Message, Meaning, Connotation, Denotation Culture/Codes etc Levels of communication: Technical, Semantic, and Pragmatic. The semiotic landscape: language and visual communication, narrative representation.

UNIT - III: METHODOLOGY 9

Fundamentals of Design: Definition. Approaches to Design, Centrality of Design, EIements/Elements of Design: Line, Shape, Space, Color, Texture. Form Etc. Principles of Design: Symmetry. Rhythm, Contrast, Balance Mass/Scale etc. Design and Designers (Need, role, process, methodologies etc.).

UNIT - IV: DESIGN PROCESS 9

Principles of Visual and other Sensory Perceptions. Color psychology and theory (some aspects) Definition, Optical / Visual Illusions Etc., Various stages of design process-problem identification, search for solution refinement, analysis, decision making, Implementation.

UNIT - V: GRAPHIC DESIGN 9

Basics of Graphic Design. Definition, Elements of GD, Design process-research, a source of concept, the process of developing ideas-verbal, visual, combination & thematic, visual thinking, associative techniques, materials, tools (precision instruments etc.) design execution, and presentation.

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

- Learn about the history & evolution of Communication.
- Understand the Nature & functions of Visual Communication.
- Acquire knowledge on different types of perception & illusion.
- Get knowledge on semiotics.
- Remember the world of ideation creating.

TEXT BOOKS:

1. Lester, E, "Visual Communications: Images with Messages", Thomson Learning, 2013.
2. Jonathan Baldwin, "Visual Communication: From Theory to Practice", AVA publishing, 2006.

REFERENCE BOOKS:

1. Schildgen, T., "Pocket Guide to color with digital applications", Thomsom Learning, 2000.
2. Palmer, Frederic, "Visual Elements of Art and Design", Longman, 1990.
3. Carter, "Typographic Design : Form and Communication", 6/e, John Wiley, 2014.

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
CO 1	3	2	1	1	1	-	-	-	-	-	-	1	3	-	-	-
CO 2	3	2	3	2	3	-	-	-	-	-	-	1	3	-	2	-
CO 3	3	2	1	2	-	-	-	-	-	-	-	-	3	2	2	-
CO 4	3	3	3	3	-	-	-	-	-	-	-	-	3	-	3	-
CO 5	3	-	2	2	3	-	-	-	-	-	-	2	2	2	3	-

1906707 **MEMS AND NEMS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

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

UNIT – I: INTRODUCTION TO MEMS AND NEMS 9

Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nanoelectromechanical systems, Materials for MEMS and NEMS: Silicon, silicon compounds, polymers, metals.

UNIT – II: MEMS FABRICATION TECHNOLOGIES 9

Photolithography, Ion Implantation, Diffusion, Oxidation, CVD, Sputtering Etching techniques, Micromachining: Bulk Micromachining, Surface Micromachining, LIGA, Micromolding.

UNIT – III: MICRO SENSORS 9

MEMS Sensors: Design of Acoustic wave sensors, Vibratory gyroscope, Capacitive Pressure sensors, Case study: Piezoelectric energy harvester.

UNIT – IV: MICRO ACTUATORS 9

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces, Case Study: RF Switch.

UNIT – V: NANO DEVICES 9

Atomic Structures and Quantum Mechanics, Shrodinger Equation, ZnO nanorods based NEMS device: Gas sensor.

TOTAL PERIODS: 45

OUTCOMES:

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

- Interpret the basics of micro/nano electromechanical systems including their applications and advantages.
- Recognize the use of materials in micro fabrication and describe the fabrication processes including surface micromachining, bulk micromachining and LIGA.
- Analyze the key performance aspects of electromechanical sensors.
- Illustrate the design of micro actuators using various actuations.
- Comprehend the theoretical foundations of quantum mechanics and Nano systems.

TEXT BOOKS:

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

REFERENCES BOOKS:

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

COURSE OUTCOMES - 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
CO 1	3	3	3	3	-	-	-	-	-	3	-	-	3	3	-	-
CO 2	3	-	3	3	-	2	1	-	-	2	-	-	3	3	-	-
CO 3	3	-	3	3	-	-	1	-	-	2	-	-	3	3	-	-
CO 4	3	2	3	3	-	-	-	1	-	2	-	-	3	3	-	-
CO 5	3	2	3	3	-	-	-	1	-	2	-	-	3	3	-	-

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.

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 PERIODS: 45

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.

REFERENCES

1. Bela G.Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
2. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010.
3. E.A. John P. Bentley, Principles of Measurement Systems, 4th 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.

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**
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO 2	-	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 3	-	-	1	-	2	3	-	-	-	-	-	1	-	-	1	-
CO 4	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-
CO 5	-	-	-	1	1	1	-	-	-	-	-	1	-	-	-	1

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 PERIODS: 45

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

REFERENCES:

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", 2nd Edn,PHI Learning Ltd (2012).
4. Amiya K. Jana,"ChemicalProcess Modelling and Computer Simulation" 2nd Edn,PHI Learning Ltd,(2012).

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
CO 1	3	3	2	3	2	-	-	-	-	-	-	1	-	-	-	-
CO 2	3	3	2	3	2	-	-	-	-	-	-	1	-	-	-	-
CO 3	3	3	2	3	3	-	-	-	-	-	-	1	-	-	-	-
CO 4	3	3	2	3	3	-	-	-	-	-	-	1	-	-	-	-
CO 5	3	3	2	3	3	-	-	-	-	-	-	1	-	-	-	-

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 PERIODS: 45

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.

REFERENCES:

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 MATRIX

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	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 3	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-

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

Eements 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 PERIODS: 45

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. (UI : Ch 1-4 ; UV : Ch 7-8) .
2. Stephen H. Kan, “Metrics and Models in Software Quality Engineering”, Pearson Education (Singapore) Pte Ltd., 2002. (UI : Ch 3-4; UIII : Ch 5-8 ; UIV : Ch 9-11).

REFERENCES

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 MATRIX

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	-

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 PERIODS: 45

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.

REFERENCES

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 MATRIX

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	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	-	3	-	2	-	-	-	-	-	-	-	-	3	-	-	-
CO 3	2	-	3	-	-	-	-	-	-	-	-	-	3	-	2	-
CO 4	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 5	2	3	3	2	-	-	-	-	-	-	-	-	3	2	-	-

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 modelling.
- 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.

UNIT V VR APPLICATION 9

Virtual Reality Applications: Introduction – Engineering – Entertainment – Science Training – The Future: Introduction – Virtual environments – modes of interaction.

TOTAL PERIODS: 45

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 modelling.
- Develop Virtual environment.
- Apply study about Virtual Hardwares and Softwares.
- Develop Virtual Reality applications and Develop Virtual Reality applications.

TEXT BOOK

1. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.
2. Adams, “Visualizations of Virtual Reality”, Tata McGraw Hill, 2000.

REFERENCES BOOKS

1. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology”, Wiley Interscience, 2nd Edition, 2006.
2. William R. Sherman, Alan B. Craig, “Understanding Virtual Reality: Interface, Application, and Design”, Morgan Kaufmann, 2008.
3. www.vresources.org.
4. www.vrac.iastate.edu.
5. www.w3.org/MarkUp/VRML.

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**
CO 1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 2	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO 3	-	2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO 4	-	2	2	-	2	-	-	-	-	-	-	-	-	3	-	-
CO 5	-	-	-	-	2	-	-	-	-	-	-	-	-	3	-	-

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.

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 PERIODS: 45

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 MATRIX

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	-	-	-	-	-	-	-	-	2	2	-	-
CO 2	3	-	2	2	-	-	-	-	-	-	-	1	2	2	-	-
CO 3	3	3	2	2	-	-	-	-	-	-	-	1	2	2	-	-
CO 4	3	-	2	3	-	-	-	-	-	-	-	1	2	2	-	-
CO 5	3	-	3	3	-	-	-	-	-	-	-	1	1	2	-	-

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 9

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo- mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL PERIODS: 45

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", 3rd Edition, Addison-Wesley Company Inc., New York, 2000.

REFERENCE BOOKS:

1. P. Field Foster, "The Mechanical Testing of Metals and Alloys" 7th Edition, Cousens Press, 2007.
2. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th 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 MATRIX

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	2	1	1	-	-	-	-	-	-	-	1	1	1	-	-
CO 2	3	2	1	1	-	-	-	-	-	-	-	1	1	1	-	-
CO 3	2	2	1	1	-	-	-	-	-	-	-	1	1	1	-	-
CO 4	3	2	1	1	-	-	-	-	-	-	-	1	1	1	-	-
CO 5	3	2	1	1	-	-	-	-	-	-	-	1	1	1	-	-

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 PERIODS: 45

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 MATRIX

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	1	1	-	1	-	1	-	-	1	2	2	1	2	-
CO 2	2	-	-	1	2	-	-	-	1	-	-	-	-	-	-	-
CO 3	1	-	1	-	-	1	-	-	-	-	1	-	-	1	1	-
CO 4	-	2	2	1	-	-	2	-	-	-	-	-	-	-	-	-
CO 5	2	2	-	1	-	-	-	-	-	-	2		2	1	1	-

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.Massspectrometer.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 PERIODS: 45

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.
- Ability to acquire knowledge on surface microscopic techniques and voltametric 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 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	2	-	-	3	-	3	2	1	2	-	-	-
CO2	2	2	3	2	2	-	-	2	2	3	2	1	2	-	-	-
CO3	2	2	3	3	3	-	2	2	2	3	3	1	2	-	-	-
CO4	3	2	3	3	3	-	-	3	2	3	3	1	2	-	-	-
CO5	3	-	3	2	2	-	-	3	-	3	2	1	2	-	-	-

1920702 **MEDICAL PHYSICS** **L T P C**

3 0 0 3

COURSE 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.

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 PERIODS: 45

COURSE OUTCOMES

- Analyze the low frequency and high frequency effects of non-ionizing radiation and physics of light.
- Define various clinical applications based on ultrasoundwave.
- Explain the process of radioactive nuclide production using differenttechniques.
- Analyze radiation mechanics involved with various physiologicalsystems.
- Outline the detrimental effects of radiation and regulations for radiationsafety.

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

1920703 ELECTRONIC MATERIALS L T P C

3 0 0 3

COURSE 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.Defectsandimperfectionsin 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 PERIODS: 45

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

1921701 **WASTE WATER TREATMENT** **L T P C**

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COURSE 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.

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

COURSE 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", 4^{th} 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 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	2	1	2	-	-	-	1	-	2	-	-	1	-	-	-	-
CO2	1	2	2	2	-	-	3	-	1	-	-	1	-	-	-	-
CO3	3	1	-	1	3	1	3	-	-	-	-	1	-	-	-	-
CO4	2	-	2	2	1	-	3	-	-	-	-	1	-	-	-	-
CO5	3	2	-	-	1	-	-	-	-	-	-	1	-	-	-	-