SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur-603203.

Medical Electronics

UG- Curricula and Syllabi

B.E – MEDICAL ELECTRONICS

REGULATION 2023

SRM VALLIAMMAI ENGINEERING COLLEGE

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

B.E. MEDICAL ELECTRONICS

REGULATIONS – 2023

1. VISION AND MISSION

Vision of the Institute

- "Educate to Excel in Social Transformation"
- To accomplish and maintain international eminence and become a model institution for higher learning through dedicated development of minds, advancement of knowledge and professional application of skills to meet the global demands**.**

Mission of the Institute

- To contribute to the development of human resources in the form of professional engineers and managers of international excellence and competence with high motivation and dynamism, who besides serving as ideal citizen of our country will contribute substantially to the economic development and advancement in their chosen areas of specialization.
- To build the institution with international repute in education in several areas at several levels with specific emphasis to promote higher education and research through strong institute-industry interaction and consultancy.

Vision of the Department

- To provide quality education for improving the healthcare and well-being of humankind.

Mission of the Department

- To inculcate students with fundamental knowledge, interdisciplinary problem solving skills and confidence required to excel in Medical Electronics.
- To up skill the students with the current technological trends and carryout Quality research to meet the expectation of healthcare service sectors.
- To instil creativity, responsibility, commitment and leadership qualities with professional ethics and moral values.

2. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To facilitate the students with the profound knowledge in Medical Electronics domain so as to enhance their skills in solving health care challenges.
2. To instigate the students to exhibit their knowledge in developing therapeutic and diagnostic equipment with societal and ethical responsibility.
3. To enable the students to exhibit the research capabilities in multidisciplinary domain with ethics and to engage in lifelong learning.
4. To enrich the graduates to emerge as Entrepreneurs and recognized experts in the field of health care engineering domain and clinical standards.

3. PROGRAMME OUTCOMES (POs):

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

PO#	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, research literature, and analyze 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 ofcomplex 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 andfinance	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.

4. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Medical Electronics program, the student will have following Program specific outcomes

1. Ability to apply the knowledge of engineering in solving the healthcare problems.

2. Ability to propose indigenous clinical solution through the application of their domain areas and emerging ICTs

4. PEO / PO Mapping:

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

Contribution: 1 – Reasonable, 2 – Significant, 3 – Strong

MAPPING – UG – MEDICAL ELECTRONICS

		Subject Code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year I	Sem I	EN3111- Professional English – I	2.2	2.6	2	2	2		2			2.8	1	1	-	-	-	-
		MA3122 - Matrices and Calculus	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
		PH3123 - Engineering Physics	2.8	1.4	1.4	1	1.25	1	1	-	-	-	-	1	-	-	-	-
		CH3124 - Engineering Chemistry	2.8	1.8	2.2	1.2	0.2	0.2	0.8	-	-	-	-	0.8	-	0.2	-	-
		GE3131 - Basic Electrical and Electronics Engineering	2.8	2.8	1.7	1.6	3	2	2	2	-	-	-	-	1.8	1.5	2.5	2
		GE3111 - தமிழர் மரபு / Heritage of Tamils																
		EN3119 - English Language Learning Laboratory	2	1	1	1	2	-	2	-	-	3	-	1	-	-	-	-
		GE3121 - Physics and Chemistry Laboratory	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-	-
		GE3134 - Engineering Practices Laboratory	3	2	2.3	2	2.3	1	-	-	1	-	1	1	1.7	2	2.5	2
Year I	Sem II	EN3211 - Professional English – II	2	2	1.4	2	2		2			2.8	1	1				
		MA3222 - Statistics and Numerical Methods	3	3	-	-	-	-	-	-	-	-	-	-	1	-	-	-
		PH3226 – Medical Physics	2.4	1.6	1.5	1.5	1.6	1.5	1	-	-	-	-	1	-	-	-	-
		CH3226 - Chemistry for Bio-Medical Engineering	2.6	2.6	2.4	1.8	1.8	0.4	0.2	-	-	-	-	0.4	0.6	0.8	0.2	-
		GE3231 - Problem Solving and Python Programming	2.4	2.6	3	2.8	1.8	-	-	-	-	-	1.6	2	2.5	-	2	1
		GE3211 – தமிழரும் தொழில்நுட்பமும் / Tamils and Technology																
		GE3233 - Engineering Graphics and Design	3	1	2	-	2	-	-	-	-	3	-	2	2	1	-	1
		GE3221 - Engineering Sciences Laboratory	3	2.4	2.6	1	1	-	-	-	-	-	-	-	-	-	-	-
		GE3232 - Problem Solving and Python Programming Laboratory	2.6	2.6	3	2.8	2.2	-	-	-	-	-	2	2	1	3	1.7	2
		GE3251 - NSS / YRC / NSO / Club Activities#																

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year II	Sem III	MA3321 - Transforms and Partial Differential Equations	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
		EC3363 - Signals and Systems	3	3	3	3	3	2	-	-	-	-	-	3	2	3	1	-
		EE3363 - Electric Circuit Analysis	1	1	1	2	2	-	-	3	-	-	3	2	1	1	2	3
		EI3361 – Electron Devices and Circuits	2.6	2.6	2.2	2	-	-	-	1		1	-	-	1.2	-	-	2
		CS3361 -Object Oriented Programming	2	1.4	2.2	2	2	–	–	–	2.2	1.8	1.2	2.4	3	1.8	2.2	1.6
		MD3361 – Sensors and Measurements	3	2.8	2	1.2	1.4	2	2	2	2	1.4	2.6	1.3	2.2	2	1.8	2.7
		EI3365- Electron Devices and Circuits Laboratory	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	1.4
		CS3364 - Object Oriented Programming Laboratory	2	2	2	2	2	–	–	–	2	2	2	2	2	2	2	2
Year II	Sem IV	MA3427 - Applied Mathematics for Bio-Medical Engineering	3	3	3	2	1	-	-	-	-	-	1	1	1	-	-	-
		MD3461 – Human Anatomy and Physiology	3	-	-	2	-	-	-	2.2	-	-	-	2	2	2	-	-
		MD3462 – Bio Control Systems	3	2	2	2	1.3	2	1		1	1	1	2	2	1	-	-
		MD3463 – Analog and Digital Integrated Circuits	3	3	3	1	1	1	-	-	-	-	2.2	2.2	1.4	1	1	-
		EC3464 - Microprocessors, Microcontrollers and Interfacing	2	1.2	2	1.7	3	1	-	2	-	-	2.5	2	2	1	3	2
		GE3451 - NCC Credit Course Level – I																
		MD3464 – Medical Instrumentation	2	2.7	2.7	2.5	3	2.5	2.5	2	2	2	-	2	2	3	3	-
		MD3465 – Analog and Digital Integrated Circuits Laboratory	3	2	1	1	1.4	-	-	-	-	1	2	3	1.8	1.2	-	-
		EC3467 - Microprocessors, Microcontrollers and Interfacing Laboratory	1.7	2	3	2	3	2	2	2	1.8	2	-	2.2	2	2	3	3

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year III	Sem V	MD3561 -Therapeutic Equipment	3	2	1	1	-	-	-	-	-	-	-	-	1	-	-	-
		MD3562 -Discrete Time Signal Processing	3	2	2	2	1	-	-	-	1	1	1	-	3	2	-	-
		MD3563 - Analog and Digital Communication	3	2	3	3	-	2	2	2	-	-	-	3	-	-	-	-
		Professional Elective – I																
		Professional Elective – II																
		CE3521 - Environmental Studies	2.8	1.8	1.0	1.0	0.0	2.2	2.4	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0
		NCC Credit Course Level – II																
		EC3564- Embedded Systems and IoT Design	3	3	3	3	3	1	-	-	-	-	-	2	2	2	3	3
		MD3564-Medical Equipment Laboratory	3	2	1	1	1	-	-	-	-	1	1	-	1	-	-	-
		MD3565-Discrete Time Signal Processing Laboratory	2.6	2	1.6	2	2.3	-	2	2	2	1.8	3.3	1.3	3	-	-	-
Year III	Sem VI	MD3661-Medical Imaging Techniques	3	2	-	2	1	1	1	2	-	1	-	1	2	2	-	-
		MD3662-Hospital Administration and Management	3	2	1	2	-	1	-	1	-	1	1	-	2	2	-	-
		MD3663-Medical Image Processing	3	2	2	2	-	-	-	-	-	-	-	2	2	2	-	-
		PXXXXX- Professional Elective – III																
		PXXXXX-Professional Elective – IV																
		MANXXX-Management - Elective #																
		MXXXXX-Mandatory Course-I																
		MD3664-Medical Image Processing Laboratory	2	3	3	2	2	3	3	3	2	2	1	1	2	3	-	-
		MD3645-Mini Project Work	1.3	2	2.5	2.7	2	1	1	1	3	2	1	2	2	2.2	-	-
		EN3649-Professional Communication Laboratory	1	1	-	1	1	1	-	-	-	2	-	1	-	-	-	-

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year IV	Sem VII	MD3761-Fundamentals of Health Care Analytics	3	1	1	1	1	1	-	-	-	-	-	1	1	-	-	-
		PXXXXX-Professional Elective – V																
		PXXXXX-Professional Elective – VI																
		BA3711 -Human Values and Ethics	-	-	1	2	-	-	1	-	-	-	-	-	-	-	-	-
		OXXXXX-Open Elective *																
		MXXXXX-Mandatory Course-II																
		EC3763-Artificial Intelligence and Machine Learning Techniques	2	3	3	2	-	-	-	-	-	-	-	2	2	2	-	-
		MD3762-Medical Electronics System Design Laboratory	1	3	3	2	-	-	-	-	2	-	-	-	3	1	-	-
		MD3743-Hospital Equipment Training#	3	-	3	3	-	3	3	3	3	3	-	3	3	2	-	-
Year IV	Sem VIII	MD3841 Project Work	3	3	3	3	2	2	3	3	3	3	3	3	3	3	-	-

Contribution: 1 – Reasonable, 2 – Significant, 3 – Strong

SRM VALLIAMMAI ENGINEEERING COLLEGE, CHENNAI

(AN AUTONOMOUS INSTITUTION)

REGULATION-2023

CHOICE BASED CREDIT SYSTEM

B.E – MEDICAL ELECTRONICS

CURRICULUM FOR SEMESTER I TO VIII

SEMESTER I								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	EN3111	Professional English – I	HSMC	3	0	0	3	3
2.	MA3122	Matrices and Calculus	BSC	3	1	0	4	4
3.	PH3123	Engineering Physics	BSC	3	0	0	3	3
4.	CH3124	Engineering Chemistry	BSC	3	0	0	3	3
5.	GE3131	Basic Electrical and Electronics Engineering	ESC	3	0	0	3	3
6.	GE3111	தமிழர் மரபு/Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICAL								
7.	EN3119	English Language Learning Laboratory	HSMC	0	0	2	2	1
8.	GE3121	Physics and Chemistry	BSC	0	0	4	4	2
9.	GE3134	Engineering Practices Laboratory	ESC	0	0	4	4	2
TOTAL				16	1	10	27	22

SEMESTER II								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	EN3211	Professional English – II	HSMC	3	0	0	3	3
2.	MA3222	Statistics and Numerical Methods	BSC	3	1	0	4	4
3.	PH3226	Medical Physics	BSC	3	0	0	3	3
4.	CH3226	Chemistry for Bio - Medical Engineering	BSC	3	0	0	3	3
5.	GE3231	Problem Solving and Python Programming	ESC	3	0	0	3	3
6.	GE3211	தமிழரும் தொழில்நுட்பமும்/ Tamils and Technology	HSMC	1	0	0	1	1
THEORY CUM PRACTICAL								
7.	GE3233	Engineering Graphics and Design	ESC	1	0	4	5	3
PRACTICAL								
8.	GE3221	Engineering Sciences Laboratory	BSC	0	0	4	4	2
9.	GE3232	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
10.	GE3251	NSS/YRC/NSO/ Club Activities#	PCD	0	0	0	0	0
TOTAL				17	1	12	30	24

 # Conducted after college hours

SEMESTER III								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MA3321	Transforms and Partial Differential Equations	BSC	3	0	0	3	3
2.	EC3363	Signals and Systems	PCC	3	0	0	3	3
3.	EE3363	Electric Circuit Analysis	PCC	3	0	0	3	3
4.	EI3361	Electron Devices and Circuits	ESC	3	0	0	3	3
5.	CS3361	Object Oriented Programming	ESC	3	0	0	3	3
THEORY CUM PRACTICAL								
6.	MD3361	Sensors and Measurements	PCC	3	0	2	5	4
PRACTICAL								
7.	EI3365	Electron Devices and Circuits Laboratory	ESC	0	0	3	3	1.5
8.	CS3364	Object Oriented programming Laboratory	ESC	0	0	3	3	1.5
TOTAL				18	0	8	26	22

SEMESTER IV								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MA3427	Applied Mathematics for Bio-Medical Engineering	BSC	2	0	0	2	2
2.	MD3461	Human Anatomy and Physiology	PCC	3	0	0	3	3
3.	MD3462	Bio Control Systems	PCC	3	0	0	3	3
4.	MD3463	Analog and Digital Integrated Circuits	PCC	3	0	0	3	3
5.	EC3464	Microprocessors, Microcontrollers, and Interfacing	PCC	3	0	0	3	3
6.	GE3451	NCC Credit Course Level – I*	PCD	3*	0	0	3*	3*
THEORY CUM PRACTICAL								
7.	MD3464	Medical Instrumentation	PCC	3	0	2	5	4
PRACTICAL								
8.	MD3465	Analog and Digital Integrated Circuits Laboratory	PCC	0	0	3	3	1.5
9.	EC3467	Microprocessors, Microcontrollers, and Interfacing Laboratory	PCC	0	0	3	3	1.5
TOTAL				17	0	8	25	21

*** NCC Credit Course level – I is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.**

SEMESTER V								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MD3561	Therapeutic Equipment	PCC	3	0	0	3	3
2.	MD3562	Discrete Time Signal Processing	PCC	3	0	0	3	3
3.	MD3563	Analog and Digital Communication	PCC	3	0	0	3	3
4.	PXXXXX	Professional Elective – I	PEC	3	0	0	3	3
5.	PXXXXX	Professional Elective – II	PEC	3	0	0	3	3
6.	CE3531	Environmental Studies	BSC	2	0	0	2	2
7.	GE3551	NCC Credit Course Level – II	PCD	3#	0	0	3	3#
THEORY CUM PRACTICAL								
8.	EC3564	Embedded Systems and IoT Design	PCC	3	0	2	5	4
PRACTICAL								
9.	MD3564	Medical Equipment Laboratory	PCC	0	0	3	3	1.5
10.	MD3565	Discrete Time Signal Processing Laboratory	PCC	0	0	3	3	1.5
				20	**0**	**8**	**28**	**24**

 # NCC Credit Course level – II is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.

SEMESTER VI								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MD3661	Medical Imaging Techniques	PCC	3	0	0	3	3
2.	MD3662	Hospital Administration and Management	PCC	3	0	0	3	3
3.	MD3663	Medical Image Processing	PCC	3	0	0	3	3
4.	PXXXXX	Professional Elective – III	PEC	3	0	0	3	3
5.	PXXXXX	Professional Elective – IV	PEC	3	0	0	3	3
6.	MANXXX	Management - Elective #	HSMC	2	0	0	2	2
7.	MXXXXX	Mandatory Course-I	MC	3	0	0	3	0
PRACTICAL								
8.	MD3664	Medical Image Processing Laboratory	PCC	0	0	3	3	1.5
9.	MD3645	Mini Project Work	EEC	0	0	4	4	2
10.	EN3649	Professional Communication Laboratory	EEC	0	0	2	2	1
				20	**0**	**9**	**29**	**21.5**

 # Management - Elective shall be chosen from the Management Elective courses.
& Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-I)

SEMESTER VII								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1.	MD3761	Fundamentals of Health Care Analytics	PCC	3	0	0	3	3
2.	PXXXXX	Professional Elective – V	PEC	3	0	0	3	3
3.	PXXXXX	Professional Elective – VI	PEC	3	0	0	3	3
4.	BA3711	Human Values and Ethics	HSMC	2	0	0	2	2
5.	OXXXXX	Open Elective *	OEC	3	0	0	3	3
6.	MXXXXX	Mandatory Course-II	MC	3	0	0	3	0
THEORY CUM PRACTICAL								
7.	EC3763	Artificial Intelligence and Machine Learning Techniques	PCC	3	0	2	5	4
PRACTICAL								
8.	MD3762	Medical Electronics System Design Laboratory	PCC	0	0	3	3	1.5
9.	MD3743	Hospital Equipment Training#	EEC	0	0	0	0	1
				20	**0**	**5**	**25**	**20.5**

***Open Elective (Shall be chosen from the list of open electives offered by other Programmes).**

& Mandatory Course-II is a Non-credit Course (Student shall select one course from the list given under Mandatory Course-II)

 # Hospital Training (2 weeks)

SEMESTER VIII								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
PRACTICAL								
1.	MD3841	Project Work	EEC	0	0	20	20	10
				0	**0**	**20**	**20**	**10**

TOTAL NO. OF CREDITS: 165

MANAGEMENT – ELECTIVE

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	MAN101	Principles of Management	HSMC	2	0	0	2	2
2.	MAN102	Total Quality Management	HSMC	2	0	0	2	2
3.	MAN103	Human Resources Management	HSMC	2	0	0	2	2
4.	MAN104	Entrepreneurship Development	HSMC	2	0	0	2	2

MANDATORY COURSES – I

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	MBA101	Introduction to Gender Studies	MC	3	0	0	3	0
2.	MEN101	Elements of Literature	MC	3	0	0	3	0
3.	MBA102	Patent Drafting for Beginners	MC	3	0	0	3	0
4.	MBA103	Industrial Psychology	MC	3	0	0	3	0
5.	MBA104	Indian Constitution	MC	3	0	0	3	0

MANDATORY COURSES – II

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	MGE201	Well Being with traditional Practices -Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
2.	MGE202	History of Science and Technology in India	MC	3	0	0	3	0
3.	MCY201	Awareness of Cyber Security and Cyber Law	MC	3	0	0	3	0
4.	MME201	Industrial Safety	MC	3	0	0	3	0

PROFESSIONAL ELECTIVE COURSES - VERTICALS

Vertical I **Bio Engineering**	**Vertical II** **Medical Device Innovation and Development**	**Vertical III** **Mechanics**	**Vertical IV** **Signal and Image Processing**	**Vertical V** **Communication**	**Verticals VI** **Advanced Health Care Devices**
Biomaterials	Foundation Skills in integrated product Development	Biomechanics	Bio signal Processing	Communication Networks	Medical Expert Systems
Artificial Organs and Implants	Medical Device Design	Physiological Modeling	Speech Processing	Wireless Communication Techniques	Human Assist Devices
Biomedical Optics and Photonics	Patient safety, Standards and Ethics	Rehabilitation engineering	Biometrics	Wearable Devices	Critical Care Equipment
Neural Engineering	Hospital Waste Management	Assistive Technology	Bio MEMS	Medical Informatics	Advancement in Diagnostic and Therapeutic Equipment
Tissue Engineering	Medical Innovation and Entrepreneurship	Ergonomics	Brain Computer Interface and its applications	Telemedicine	Robotics in Medicine
Genetic Engineering	Rapid Prototyping	Haptics	Computer Vision	Virtual reality and Augmented Reality in Healthcare	Advancements in Healthcare Technology

Registration of Professional Elective Courses from Verticals:

Professional Elective Courses will be registered in Semesters V , VI and VII . These courses are listed in groups called verticals that represent a particular area of specialization / diversified group. Students are permitted to choose all the Professional Electives from a particular vertical or from different verticals. Further, only one Professional Elective course shall be chosen in a semester horizontally (row-wise). However, two courses are permitted from the same row, provided one course is enrolled in Semester V and another in semester VI.

The registration of courses for B.E./B.Tech (Honours) or Minor degree shall be done from Semester V to VIII. The procedure for registration of courses explained above shall be followed for the courses of B.E/B.Tech (Honours) or Minor degree also. For more details on B.E./B.Tech (Honours) or Minor degree refer to the Regulations 2023, Clause 19.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: BIO ENGINEERING								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PMD101	Biomaterials	PEC	3	0	0	3	3
2.	PMD102	Artificial Organs and Implants	PEC	3	0	0	3	3
3.	PMD103	Biomedical Optics and Photonics	PEC	3	0	0	3	3
4.	PMD104	Neural Engineering	PEC	3	0	0	3	3
5.	PMD105	Tissue Engineering	PEC	3	0	0	3	3
6.	PMD106	Genetic Engineering	PEC	3	0	0	3	3

VERTICAL 2: MEDICAL DEVICE INNOVATION AND DEVELOPMENT								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PME207	Foundation Skills in integrated Product Development	PEC	3	0	0	3	3
2.	PMD201	Medical Device Design	PEC	3	0	0	3	3
3.	PMD202	Patient safety, Standards and Ethics	PEC	3	0	0	3	3
4.	PMD203	Hospital Waste Management	PEC	3	0	0	3	3
5.	PMD204	Medical Innovation and Entrepreneurship	PEC	3	0	0	3	3
6.	PME208	Rapid Prototyping	PEC	3	0	0	3	3

VERTICAL 3: MECHANICS								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PMD301	Biomechanics	PEC	3	0	0	3	3
2.	PMD302	Physiological Modeling	PEC	3	0	0	3	3
3.	PMD303	Rehabilitation Engineering	PEC	3	0	0	3	3
4.	PMD304	Assistive Technology	PEC	3	0	0	3	3
5.	PMD305	Ergonomics	PEC	3	0	0	3	3
6.	PMD306	Haptics	PEC	3	0	0	3	3

VERTICAL 4: SIGNAL AND IMAGE PROCESSING								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PMD401	Bio signal Processing	PEC	3	0	0	3	3
2.	PEC203	Speech Processing	PEC	3	0	0	3	3
3.	PMD402	Biometrics	PEC	3	0	0	3	3
4.	PMD403	Bio MEMS	PEC	3	0	0	3	3
5.	PMD404	Brain Computer Interface and its Applications	PEC	3	0	0	3	3
6.	PCS505	Computer Vision	PEC	3	0	0	3	3

VERTICAL 5: COMMUNICATION								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PEC607	Communication Networks	PEC	3	0	0	3	3
2.	PMD501	Wireless Communication Techniques	PEC	3	0	0	3	3
3.	PMD502	Wearable devices	PEC	3	0	0	3	3
4.	PMD503	Medical Informatics	PEC	3	0	0	3	3
5.	PMD504	Telemedicine	PEC	3	0	0	3	3
6.	PMD505	Virtual Reality and Augmented Reality in Healthcare	PEC	3	0	0	3	3

VERTICAL 6: ADVANCED HEALTH CARE DEVICES								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PMD601	Medical Expert Systems	PEC	3	0	0	3	3
2.	PMD602	Human Assist Devices	PEC	3	0	0	3	3
3.	PMD603	Critical Care Equipment	PEC	3	0	0	3	3
4.	PMD604	Advancement in Diagnostic and Therapeutic Equipment	PEC	3	0	0	3	3
5.	PMD605	Robotics in Medicine	PEC	3	0	0	3	3
6.	PMD606	Advancements in Healthcare Technology	PEC	3	0	0	3	3

S. No.	Course Code	Course Title	Course Offering Department	Contact Periods				C
				L	T	P	Total	
1.	OAG101	Environment and Agricultural Engineering	Agri	3	0	0	3	3
2.	OAG102	Organic Farming for Sustainable Agricultural Production	Agri	3	0	0	3	3
3.	OAG103	Sustainable Development Through Indian Knowledge System	Agri	3	0	0	3	3
4.	OCE101	Air and Noise Pollution Control Engineering	Civil	3	0	0	3	3
5.	OCE102	Environmental Impact Assessment	Civil	3	0	0	3	3
6.	OCE103	Green Building Design	Civil	3	0	0	3	3
7.	OAD101	Foundation of Data Science	AI&DS	3	0	0	3	3
8.	OAD102	Open Source Software Tools	AI&DS	3	0	0	3	3
9.	OCS101	IoT and its Applications	CSE	3	0	0	3	3
10.	OCS102	Machine Learning with R	CSE	3	0	0	3	3
11.	OCS103	Tamil Computing	CSE	3	0	0	3	3
12.	OCY101	Cyber Forensic and Investigation	CYB	3	0	0	3	3
13.	OCY102	Social Media Security	CYB	3	0	0	3	3
14.	OEC101	Introduction to 5G Communication Networks	ECE	3	0	0	3	3
15.	OEC102	Introduction to Industrial IoT	ECE	3	0	0	3	3
16.	OEC103	Arduino Programming and its applications	ECE	3	0	0	3	3
17.	OEE101	Renewable Energy Sources	EEE	3	0	0	3	3
18.	OEE102	Energy Conservation and Management	EEE	3	0	0	3	3
19.	OEE103	Electric and Hybrid Vehicles	EEE	3	0	0	3	3
20.	OEI101	Fundamentals of Robotics	EIE	3	0	0	3	3
21.	OEI102	Sensors for Engineering Applications	EIE	3	0	0	3	3
22.	OIT101	Multimedia Technologies	IT	3	0	0	3	3
23.	OIT102	3D Printing and its Applications	IT	3	0	0	3	3
24.	OIT103	Web Frameworks	IT	3	0	0	3	3
25.	OME101	Refrigeration and Air Conditioning	MECH	3	0	0	3	3
26.	OME102	Advanced Manufacturing Processes	MECH	3	0	0	3	3
27.	OME103	Material Testing and Characterization	MECH	3	0	0	3	3
28.	OME104	Hazardous Waste Management	MECH	3	0	0	3	3

29.	OME105	Automotive Engineering	MECH	3	0	0	3	3
30.	OCH101	Nanomaterials and applications	CHE	3	0	0	3	3
31.	OPH101	Advanced Functional Materials	PHY	3	0	0	3	3

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

SUMMARY

SL NO.	SUBJECT AREA	CREDIT AS PER SEMESTER								CREDITS TOTAL	%
		I	II	III	IV	V	VI	VII	VIII		
1.	**HSMC**	5	4				2	2		12	**7.27%**
2.	**BSC**	12	12	3	2	2				31	**18.78%**
3.	**ESC**	5	8	9						22	**13.33%**
4.	**PCC**			10	19	16	10.5	8.5		64	**38.78%**
5.	**PEC**					6	6	6		18	**10.90%**
6.	**PCD**		1#								
7.	**OEC**							3		3	**1.81%**
8.	**EEC**						3	1	10	15	**9.09%**
9.	**Non-Credit /(Mandatory)**						√	√			
	TOTAL	**22**	**24**	**22**	**21**	**24**	**21.5**	**20.5**	**10**	**165**	**100%**

TOTAL NO. OF CREDITS: 165

COURSES IN MINOR DEGREE
OFFERED BY DEPARTMENT OF MANAGEMENT STUDIES
DEPARTMENT OF AGRICULTURAL ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FOR B.E / B.TECH (HONOURS) / OPTIONAL COURSES (R2023)

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

Enrolment for B.E. / B. Tech. (Honours) / Minor degree (Optional) A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also. Complete details are available in clause 19 of Regulations 2023.

VERTICALS FOR MINOR DEGREE (In addition to all the verticals of other programmes)

VERTICAL I	VERTICAL II	VERTICAL III	VERTICAL IV	VERTICAL V
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management	Constitution of India	Data mining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Block chain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis

VERTICAL I: FINTECH AND BLOCKCHAIN								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM101	Financial Management	PEC	3	0	0	3	3
2	BAM102	Fundamentals of Investment	PEC	3	0	0	3	3
3	BAM103	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4	CSM101	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5	BAM104	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6	BAM105	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL II: ENTREPRENEURSHIP								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM201	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2	BAM202	Team Building and Leadership Management for Business	PEC	3	0	0	3	3
3	BAM203	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4	BAM204	Principles of Marketing Management for Business	PEC	3	0	0	3	3
5	BAM205	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6	BAM206	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL III: PUBLIC ADMINISTRATION								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM301	Principles of Public Administration	PEC	3	0	0	3	3
2	BAM302	Constitution of India	PEC	3	0	0	3	3
3	BAM303	Public Personnel Administration	PEC	3	0	0	3	3
4	BAM304	Administrative Theories	PEC	3	0	0	3	3
5	BAM305	Indian Administrative System	PEC	3	0	0	3	3
6	BAM306	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL IV: BUSINESS DATA ANALYTICS								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM401	Statistics For Management	PEC	3	0	0	3	3
2	BAM402	Data Mining For Business Intelligence	PEC	3	0	0	3	3
3	BAM403	Human Resource Analytics	PEC	3	0	0	3	3
4	BAM404	Marketing And Social Media Web Analytics	PEC	3	0	0	3	3
5	BAM405	Operation And Supply Chain Analytics	PEC	3	0	0	3	3
6	BAM406	Financial Analytics	PEC	3	0	0	3	3

VERTICAL V: ENVIRONMENT AND SUSTAINABILITY								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	AGM501	Sustainable infrastructure Development	PEC	3	0	0	3	3
2	AGM502	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3	AGM503	Sustainable Bio Materials	PEC	3	0	0	3	3
4	AGM504	Materials for Energy Sustainability	PEC	3	0	0	3	3
5	AGM505	Green Technology	PEC	3	0	0	3	3
6	AGM506	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3

EN3111	PROFESSIONAL ENGLISH – I	L T P C
		3 0 0 3

OBJECTIVES:

- To upgrade the English language skills of students by introducing communication techniques, speaking and grammar learning activities which are relevant to authentic contexts.
- To improve the basic reading and writing skills of the learners.
- To enhance the communicative competence of the first-year engineering students.
- To enable learners to use language effectively in academic/work contexts.
- To help learners understand content- context in relevant situations.

UNIT – I: INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION 9

Listening: Podcast watching – Listening for new words and pronunciation.

Speaking: Note of appreciation for classmates /family member – formal appreciation of someone, expression of feelings.

Reading: Books, shorts stories to be read. Filling forms (i.e.) post office or bank.

Writing: Film and series Review / Book Review, Email and Informal letters.

Language and Vocabulary development: WH questions, Yes/No questions, Single Word Substitutes, Pronouns, Parts of Speech, Question tags, Prefixes and Suffixes.

UNIT – II: NARRATION AND SUMMATION 9

Listening: Books – Short Stories to be read aloud in class for listening purpose.

Speaking: Short stories to be read and narrated in the class.

Reading: Reading favourite blogs on Travel, Sports and Food and expressing opinions regarding the same.

Writing: Paragraph writing, Report — field trip / I.V., Autobiography and Comprehension.

Language and Vocabulary development: Tenses – Past, Antonyms, Synonyms, Subject Verb agreement and Prepositions.

UNIT – III: DESCRIPTION OF A PROCESS/PRODUCT 9

Listening: Listening to snippets from celebrities/ National leaders' lives.

Speaking: Narrating personal experiences/ events — Expression of emotions and feelings.

Reading: Reading short biographies – famous people and description of the same. **Writing:** Instruction, Product / Process description and Advertisements (classified advertisement and display advertisement)

Language and Vocabulary development: Adjectives- Degrees of Comparison, Tenses — Present, Compound Nouns, Homonyms, Homophones and Discourse markers — connective and sequence words

UNIT – IV: CLASSIFICATION AND INTERPRETATION 9

Listening: Listening to Ted Talks.

Speaking: Recreating a Ted talk session in the class.

Reading: Newspaper Reading (Editorial) and understanding.

Writing: Note making, Blogging, Interpretation of charts and graphs.

Language and Vocabulary development: Articles, Collocations and Phrasal Verbs.

UNIT – V: EXPRESSION OF THOUGHTS AND IDEAS 9

Listening: Listening to audio books and answering questions.

Speaking: Presentation on a non-technical topic.

Reading: Editorials from newspaper.

Writing: Essay writing – Descriptive and Narrative essays.

Language and Vocabulary development: Tenses — future, Negative statements and questions, Punctuations, Cause and Effect, Content and Function words.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: To strengthen the basics of grammar.

CO2: To narrate informal and informal situations.

CO3: To describe a process/product and express opinion.

CO4: To interpret and analyse the content/information given.

CO5: To write short essays, personal letters, and emails in English.

TEXT BOOKS:

1. English for Science and Technology Cambridge University Press,2021. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, Dr. Deep Mary Francis, Dr.K.N.Shoba and Dr.Lourdes Joevani, Department of English, Anna University.
2. Technical Communication – Principles and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2016, New Delhi.

REFERENCES:

1. Effective Communication Skill, Kulbhusan Kumar, R.S.Salaria, Khanna Publishing House.
2. Wings of Fire - An Autobiography by A.P.J Abdul Kalam with Arun Tiwari, Sangam Books Ltd , Edition: 50, 1999
3. World's Most Popular Short Stories Saki Maupassant, Anton Chekhov, O Henry Paperback
4. Professional Speaking skills, Aruna Koneru, Oxford University Press.
5. English For Engineers and Technologists, Orient Blackswan Private Ltd. Department of English,Anna University,2020.

CO - PO and CO - PSO MAPPING

Course Outcomes	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	2	2	2	-	-	-	-	3	-	-	-	-	-	-
CO2	2	2	-	-	-	-	-	-	-	3	1	1	-	-	-	-
CO3	2	-	2	2	-	-	-	-	-	3	-	1	-	-	-	-
CO4	3	3	-	2	-	-	2	-	-	3	-	-	-	-	-	-
CO5	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
AVG	**2.2**	**2.6**	**2**	**2**	**2**	**-**	**2**	**-**	**-**	**2.8**	**1**	**1**	**-**	**-**	**-**	**-**

MA3122	MATRICES AND CALCULUS	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.
- Vector calculus can be widely used for modeling the various laws of physics.
- 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

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 OF ONE VARIABLE 9L+3T

Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Rolle's Theorem and Mean Value theorem -Taylor's series- Maxima and Minima of functions of one variable.

UNIT-III: DIFFERENTIAL CALCULUS 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: 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 Polar coordinates - Triple integrals - Volume of solids.

UNIT-V: VECTOR CALCULUS **9L+3T**

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

TOTAL: 45L +15T PERIODS

OUTCOMES:

On completion of the course, student will be able to

CO1: To apply the idea of reducing complex problems into simple form using matrix technique.

CO2: Basic application of calculus in engineering problems and to tackle for different geometries.

CO3: This course equips the students to have basic knowledge and understanding the Partial derivatives and maxima and minima by Lagrange's method.

CO4: Basic application of Double and Triple integrals used in Engineering real life problems

CO5: To study the vector differentiation and vector integration by using standard theorems.

TEXT BOOKS:

1. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.3. Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", S.Chand Private Ltd.,11th Edition, 2005.
2. Veerarajan.T, "Engineering Mathematics", McGrawHill Education(India) Private Ltd 2019.

REFERENCE BOOKS:

1. Bali N.P and Manish Goyal, "A Text book of Engineering Mathematics", Eigth Edition, Laxmi Publications Pvt. Ltd., 2011.
2. James Stewart, " Calculus : Early Transcendentals ", Cengage Learning, 8th Edition, New Delhi, 2015.

3. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, Pearson Publishing, 2017.
4. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.

CO - PO and CO - PSO MAPPING

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

No Correlation - Low 1 Medium 2 High 3

PH3123	ENGINEERING PHYSICS	L	T	P	C
	(Common to all Branches of B.E./B.Tech. Programmes)	3	0	0	3

OBJECTIVES:

- To enhance the fundamental knowledge in crystalline materials and its applications.
- To explore the knowledge in the production of ultrasonic waves and application in the engineering field.
- To familiarize the basics of laser and their technical advances in scientific, industrial and health care areas.
- To understand the principle of fibre optical fibre and its applications.
- To explore basic concept of quantum and dual nature of particle.

UNIT-I: PROPERTIES OF MATERIALS 9

Elasticity - Hooke's law - Stress-strain and its uses - Poisson ratio - factors affecting elastic modulus and tensile strength.

Single crystalline, polycrystalline and amorphous materials - unit cell - space lattice - crystal systems - Bravais lattice - Miller indices - d-spacing - characteristics of unit cell - SC, BCC, FCC and HCP structure - - thermal and mechanical properties of materials - crystal growth techniques - Czochralski and Bridgmann.

UNIT-II: ULTRASONICS 9

Introduction - Properties - Production: Magnetostriction method and Piezoelectric method - Acoustical grating - determination of ultrasonic velocity in liquid - Application: Detection of flaw in materials (Non Destructive Testing) - ultrasonic soldering, welding - SONAR - diagnostic sonography - cars' air bag sensor-dispersion of fog - Probe sonication for 2D material formation.

UNIT-III: LASERS AND ITS APPLICATIONS 9

Basic concepts and characteristics - Einstein's A and B coefficients (derivation) - population inversion - Pumping methods - Nd-YAG laser - CO2 laser - Semiconductor lasers: homo junction and heterojunction - applications: laser welding, laser cutting, laser cooling, pattern formation by laser etching, laser bar

code scanner - LIDAR - Laser tissue interaction, laser surgery - Holography - NLO - electro-optic effect.

UNIT-IV: FIBRE OPTICS 9

Structure and principle - Propagation of light through optical fibre - acceptance angle, numerical aperture - fractional index change - Types of optical fibres (material, mode and refractive index) - Attenuation: absorption, scattering and bending - Dispersion - Fibre optic communication system (Block diagram) and advantages over conventional methods - fibre optic sensors: pressure and displacement- Endoscope.

UNIT-V: QUANTUM PHYSICS 9

Black body radiation and energy distribution spectrum - Planck's theory of radiation - matter waves - de-Broglie wavelength in terms of energy, voltage and temperature - Electron diffraction - G.P.Thomson experiment - wave function and its physical significance - Schrödinger's wave equation - time independent and time dependent equations - Particle in a one-dimensional box- Normalization of wave function - Quantum Tunnelling - Scanning Tunnelling Microscope.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, student will be able to

CO1: To understand the crystalline material, crystal defects and growth techniques.

CO2: To understand the basics, generation and application of ultrasonics.

CO3: To acquire knowledge on the concepts of lasers and their applications in industry and medical field.

CO4: To conversant on principle behind the fibres and their applications in communication and devices made out of optical fibre.

CO5: To get knowledge on advanced physics concepts of quantum theory and its applications.

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.
5. M.N.Avadhanulu & P.G.Kshirasagar, “A Text Book of Engineering Physics” — IX Edition, S.Chand Publications, 2014.
6. V.Rajendiran, Engineering Physics, Tata McGraw-Hill, New Delhi. 2011.

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. Shatendra Sharma & Jyotsna Sharma, “Engineering Physics”. Pearson, 2018.

CO - PO and CO - PSO MAPPING

Course Outcomes	PROGRAM OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	-	-	1	1	-	-	-	-	1	-	-	-	-
2	3	1	1	1	2	1	1	-	-	-		1	-	-	-	-
3	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
5	2	1	1	1	1	1	1	-	-	-	-	1	-	-	-	-
Avg	**2.8**	**1.4**	**1.4**	**1**	**1.25**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**

1 - low, 2 – medium, 3 – high, ‘-‘ – no correlation

CH3124	ENGINEERING CHEMISTRY	L	T	P	C
	(First Semester-Common to all branches)	3	0	0	3

OBJECTIVES

- To make the students familiar with boiler feed water requirements, related problems and domestic water treatment techniques.
- To introduce the basic concepts and applications of chemical thermodynamics.
- To acquaint the student with the principles of chemical kinetics and its applications towards engineering.
- To make the student conversant with the basics of surface chemistry and catalysis.
- To inculcate the students with the basics principles and preparatory methods of nanomaterials.

UNIT I WATER TECHNOLOGY 9

Introduction-sources of water-impurities present in water-hard water and hardness - types, Municipal water treatment: primary treatment and disinfection - Desalination of brackish water: Reverse Osmosis, Boiler troubles: scale and sludge, caustic embrittlement, boiler corrosion priming and foaming, Treatment of boiler feed water - Internal treatment (phosphate, colloidal, sodium aluminate and Calgon conditioning). External treatment: Ion exchange process, cooling waters (Langelier index).

UNIT II CHEMICAL THERMODYNAMICS 9

Introduction-terminology of thermodynamics, the first law of thermodynamics: enthalpy, 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, Criteria of spontaneity; Gibbs-Helmholtz equation, Clausius-Clapeyron equation, Maxwell relations, Van't Hoff isotherm and isochore.

UNIT III CHEMICAL KINETICS 9

Introduction-factors influencing the rate of reaction, order and molecularity of a reaction, kinetic equations of different orders (first, second and third order) — determination of the order of a reaction, the temperature dependence of reaction rates, unimolecular reactions, photochemical reactions and chain reactions, Theories of reaction rates, lasers in chemistry, fast reactions.

UNIT IV SURFACE CHEMISTRY AND CATALYSIS 9

Adsorption: classification - adsorption of gases on solids - adsorption from solutions - adsorption isotherms - applications of adsorption - Freundlich's adsorption isotherm - Langmuir's adsorption isotherm, B.E.T isotherm. Catalysis: introduction - types of catalysis - criteria - autocatalysis - catalytic poisoning and catalytic promoters - acid - base catalysis - enzyme catalysis - Michaelis - Menten equation.

UNIT V NANOCHEMISTRY 9

Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties; Types of nanomaterials: Definition, properties and uses of - nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electrospinning. Applications of nanomaterials in medicine, agriculture, food science and energy resources.

Total Periods: 45

OUTCOMES

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

CO1: To infer the quality of water from quality parameter data and propose, Suitable treatment.

CO2: To apply the knowledge of chemical thermodynamics for material design and aspects

CO3: To recommend the proper chemical kinetics for engineering processes and applications.

CO4: To recognize the surface morphology and its engineering applications.

CO5: To identify and apply basic concepts of nanoscience and nanotechnology In designing the synthesis of nanomaterials for engineering and technology applications.

TEXTBOOKS

1. Payal B. Joshi and Shashank Deep, “Engineering Chemistry”, Oxford University Press, New Delhi, 2019.
2. Shikha Agarwal, “Engineering Chemistry”-Fundamentals and Applications, 2nd Edition, Cambridge University Press, New Delhi, 2019.
3. P. C. Jain and Monica Jain, “Engineering Chemistry”, 18th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2021.

REFERENCES

1. R. V. Gadag and A. Nithyananda Shetty, “Engineering Chemistry”, 3rd Edition, Wiley & I.K. International (P), LTD, New Delhi, 2019.
2. S.S. Dara and S.S. Umare, “A Text Book of Engineering Chemistry”, 12th Edition, S. Chand & Company LTD, New Delhi, 2018.
3. B. Sivasankar, “Engineering Chemistry”, Tata McGraw-Hill Publishing Company LTD, 2023.
4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Text book of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.

CO - PO and CO - PSO MAPPING

Course Out comes	**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	3	-	-	-	-	2	-	-	-	-
CO2	3	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	3	2	1	-	1	-	-	-	-	2	-	1	-	-
AVG	**2.8**	**1.8**	**2.2**	**1.2**	**0.2**	**0.2**	**0.8**	**-**	**-**	**-**	**-**	**0.8**	**-**	**0.2**	**-**	**-**

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

GE3131	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments.

UNIT-I ELECTRICAL CIRCUITS 9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor — Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources — Simple problems- Nodal Analysis, Mesh analysis with independent sources only (Steady state) Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor — Steady state analysis of RLC circuits (Simple problems only).

UNIT-II ELECTRICAL MACHINES 9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, working principle and Applications of Transformer, three phase Alternator, Synchronous motor and Three Phase Induction Motor.

UNIT-III ANALOG ELECTRONICS 9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications — Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET, IGBT — Types, I-V Characteristics and Applications, Rectifier and Inverters.

UNIT-IV DIGITAL ELECTRONICS 9

Review of number systems, binary codes, error detection and correction codes,

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations – minimization using K maps (Simple Problems only).

UNIT-V MEASUREMENTS AND INSTRUMENTATION 9

Functional elements of an instrument, Standards and calibration, Operating Principle, types Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Ability to compute the electric circuit parameters for simple problems

CO2: Ability to explain the working principle and applications of electrical machines

CO3: Ability to analyze the characteristics of analog electronic devices

CO4: Ability to explain the basic concepts of digital electronics

CO5: Ability to explain the operating principles of measuring instruments

TEXTBOOKS

1. Kothari DP and I.J Nagrath, “Basic Electrical and Electronics Engineering”, Second Edition, McGraw Hill Education, 2020
2. S.K. Bhattacharya “Basic Electrical and Electronics Engineering”, Pearson Education, Second Edition, 2017.
3. Sedha R.S., “A textbook book of Applied Electronics”, S. Chand & Co., 2008
4. James A. Svoboda, Richard C. Dorf, “Dorf’s Introduction to Electric Circuits”, Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney ‘A Course in Electrical & Electronic Measurements & Instrumentation’, Dhanpat Rai and Co, 2015.

REFERENCE BOOKS

1. Thomas L. Floyd, ‘Digital Fundamentals’, 11th Edition, Pearson Education, 2017.
2. Albert Malvino, David Bates, ‘Electronic Principles, McGraw Hill Education; 7th edition, 2017.

3. Mahmood Nahvi and Joseph A. Edminister, “Electric Circuits”, Schaum’ Outline Series, McGraw Hill, 2002.
4. H.S. Kalsi, ‘Electronic Instrumentation’, Tata McGraw-Hill, New Delhi, 2010

CO - PO and CO - PSO MAPPING

	PO												**PSO**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	3	2	2			3						2		2	
CO2	3	2				2		2					1	2		2
CO3	2	3	2	2									3			
CO4	3	3	1		3		2						1		3	
CO5	3	3	2	1			1						2	1		2
Average	**2.8**	**2.8**	**1.7**	**1.6**	**3**	**2**	**2**	**2**					**1.8**	**1.5**	**2.5**	**2**

GE3111	தமிழர்மரபு	L T P C
		1 0 0 1

அலகு I: மமொழி மற்றும் இலக்கியம் 3

இந்திய மமொழிக் குடுமம்பங்கள் — திரொவிட மமொழிகள்- தமிழ் ஒரு மெமம்மமொழி- தமிழ் மெவ்விலக்கியங்கள்- ெங்க இலக்கியத்தின் மெய்

ெொர்பற்ற தன்மம — ெங்க இலக்கியத்தில் பகிர்தல் அறமம்- திருக்குறளில் மமலொண்மமக் கருத்Fகள்- தமிழ்க் கொப்பியங்கள், தமிழகத்தில் மெண மபௌத்த மெயங்களின் தொக்கமம் — பக்தி இலக்கியமம், ஆழ்வொர்கள் மற்றுமம் நொயன்மொர்கள்- சிற்றிலக்கியங்கள்- தமிழில் நவீன இலக்கியத்தின் வளர்ெ்சி — தமிழ் இலக்கிய வளர்ெ்சியில் பொரதியொர் மற்றுமம் பொரதிதொென் ஆகிமயொரின் பங்களிப்பு

அலகு II: மரபு – பொறற ஓவியங்கள் முதல் நவீன ஓவியங்கள் – சிற்பக் கறல 3

நடுகல் முதல் நவீன சிற்பங்கள் வமர –ஐமம்மபொன் சிமலகள் - பழங்குடியினர் மற்றுமம் அவர்கள் தயொரிக்குமம் மகவிமனப் மபொருட்கள் , மபொமம்மமகள்- மதர் மெய்யுமம் கமல — சுடுமண் சிற்பங்கள்.

அலகு III: நொட்டுபுறக் கறலகள் மற்றும் வீர விறளயொட்டுகள் 3

நொட்டுப்புற கமதகள், பொடல்கள்-மதருக்கூத்F, கரகொட்டமம், வில்லுப்பொட்டு, கணியொன் கூத்F- ஓயிலொட்டமம், மதொல்பொமவக் கூத்F, சிலமம்பொட்டமம்- வளரி, புலியொட்டமம், தமிழர்களின் விமளயொட்டுகள்.

அலகு IV: தமிழர்களின் திறைக் ககொட்பொடுகள் 3

தமிழகத்தின் தொவரங்களுமம், விலங்குகளுமம் – மதொல்கொப்பியமம் மற்றுமம் ெங்க இலக்கியத்தில் அகமம் மற்றுமம் புறக் மகொட்பொடுகள்- தமிழர்கள்

மபொற்றிய அறக்மகொட்பொடு –தமிழ் ெங்கமம்-ெங்கமம் வளர்த்த தமிழ்-ெங்ககொலத்தில் தமிழகத்தில் எழுத்தறிவுமம், கல்வியுமம்-ெங்ககொல நகரங்களுமம் Fமறமுகங்களுமம் — ெங்ககொலத்தில் ஏற்றுமதி மற்றுமம் இறக்குமதி கடல்கடந்த நொடுகளில் மொழர்களின் மவற்றி

அலகு V: இந்திய கதசிய இயக்கம் மற்றும் இந்திய ப்பொட்டிற்குத் தமிழர்களின் பங்களிப்பு **3**

இந்திய விடுதமலப்மபொரில் தமிழர்களின் பங்கு இந்தியொ மற்றுமம் மவளிநொட்டின் பிற பகுதிகளின் தமிழ்ப் பண்பொட்டின் தொக்கமம்-சுயமமொரியொமத இயக்கமம் — இந்திய மருத்Fவத்தில், சித்த மருத்Fவத்தின் பங்கு- கல்மவட்டுகள், மகமயழுத்Fப்படிகள் — தமிழ்ப் புத்தகங்களின் அெசு வரலொறு

Total Periods: 15 hours

TEXT CUM REFERENCES:

1. தமிழக வரலொறு — மக்களுமம் பண்பொடுமம் — மக.மக.பிள்மள (மவளியீடு: தமிழ்நொடு பொடநூல் மற்றுமம் கல்வியியல் பணிகள் கழகமம்).
2. கணினித்தமிழ் – முமனவர். இல.சுந்தரமம். (விகடன் பிரசுரமம்)
3. கீழடி — மவமக நதிக்கமரயில் ெங்ககொல நகர நொகரிகமம் (மதொல்லியல் Fமற மவளியீடு)
4. மபொருமந — ஆற்றங்கமர நொகரிகமம். (மதொல்லியல் Fமற மவளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL — (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) — Reference Book.

GE3111	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamilas a Classical Language - Classical Literature in Tamil — Secular Nature of Sangam Literature — Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modernsculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making -Massive Terracotta sculptures, Village deities.

UNIT III FOLK AND MARTIAL ARTS 3

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS 3

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils –Tamil Sangam- Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India — Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine — Inscriptions & Manuscripts — Print History of TamilBooks.

Total Periods: 15 hours

TEXT CUM REFERENCES:

1. தமிழக வரலொறு — மக்களுமஂ பண்பொடுமஂ — மக.மக.பிள்மள (மவளியீடு: தமிழ்நொடு பொடநூல் மற்றுமஂ கல்வியியல் பணிகள் கழகமஂ).
2. கணினித்தமிழ் – முமனவர். இல.சுந்தரமஂ. (விகடன் பிரசுரமஂ)
3. கீழடி — மவமக நதிக்கமரயில் ெங்ககொல நகர நொகரிகமஂ (மதொல்லியல் Fமற மவளியீடு)
4. மபொருமந — ஆற்றங்கமர நொகரிகமஂ. (மதொல்லியல் Fமற மவளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL — (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City C ivilization on the banks of river Vaigai’ (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) — Reference Book.

EN3119 ENGLISH LANGUAGE LEARNING LABORATORY L T P C

0 0 2 1

COURSE OBJECTIVE:

The course aims to

- Enhance the employability and career skills of students.
- Orient the students towards grooming as a professional.
- Make them industry ready.
- Develop their confidence and help them attend interviews successfully.
- Help students to interact confidently in a professional scenario.

UNIT I : PRONUNCIATION 6

Tone- Pronunciation – Intonation- Reading Aloud and Addressing- Syllable- Rhythm- Accent- Wrongly Pronounced words -Poetry Reading.

UNIT II : NON VERBAL COMMUNICATION 6

Non Verbal Communication - Facial expressions- Eye contact - Subtle (and not so subtle) gestures -Tone of voice — Touch- Posture -Personal space.

UNIT III : SELF INTRODUCTION AND PRESENTATION 6

Self-Introduction- Introducing oneself to the audience- Introducing the Topic — answering questions — Individual Presentation Practice — Presenting Visuals effectively -5 Minute Presentations.

UNIT *IV : BASICS OF SOFT SKILLS 6

Recognizing differences between groups and teams – managing time – networking professionally – Respecting social protocols- understanding career management – Developing a long - term career plan- making career changes.

UNIT V : GROUP DISCUSSION 6

Introduction to Group Discussion — Participating in Group discussions — Understanding group dynamics — Brainstorming the Topic — Questioning and Clarifying – GD Strategies – activities to improve GD Skills.

TOTAL: 30 PERIODS

COURSE OUTCOME:

On completion of the course, student will be able to

CO1: Pronounce the words correctly.

CO2: Understand the nonverbal clues.

CO3: Make an effective presentation.

CO4: Adequate soft skills required for the workplace.

CO5: Participate confidently in Group Discussions.

REFERENCES:

1. Professional Communication by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2014.
2. Soft Skills by S. Hariharan , N. Soundarajaran and S.P. Shanmugapriya MJP Publishers, Edition: 2013
3. Soft Skills for Everyone by Butterfield , Jeff, Cengage Learning India Pvt. Ltd.,2015. New Delhi.

CO - PO and CO - PSO MAPPING

Course Outcomes	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	-	-	-	1	-	-	-	-	-	3	-	1	-	-	-	-
CO2	1	1	-	-	-	-	1	-	-	2	-	1	-	-	-	-
CO3	2	2	1	2	2	-	-	-	-	3	-	1	-	-	-	-
CO4	2	1	1	-	-	-	3	-	-	3	-	1	-	-	-	-
CO5	-	1	-	1	-	-	-	-	-	3	-	1	-	-	-	-
Avg	**1.7**	**1.3**	**1**	**1.3**	**2**	**-**	**2**	**-**	**-**	**2.8**	**-**	**1**	**-**	**-**	**-**	**-**

GE3121	PHYSICS AND CHEMISTRY LABORATORY	L T P C 0 0 4 2

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

OBJECTIVES:

- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 5 Experiments)

1. Calculation of lattice cell parameter – X-ray diffraction method.
2. Determination of velocity of sound and compressibility of liquid — Ultrasonic interferometer
3. (a). Compact disc- Determination of width of the groove using Laser.
   (b). Determination of particle size using Laser
4. (a) Determination of wavelength using Laser
   (b) Determination of acceptance angle and numerical aperture in an optical fiber.
5. Determination of Planck's constant using LED.
6. Determination of thickness of a thin wire – Air wedge method
7. Determination of wavelength of mercury spectrum – spectrometer grating
8. Determination of rigidity modulus – Torsion pendulum
9. Determination of Young's modulus by non-uniform bending method.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, the students should be able

CO1: Understand the functioning of various physics laboratory equipment.

CO2 Use graphical models to analyze laboratory data.

CO3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.

CO4: Access, process and analyze scientific information.

CO5: Solve problems individually and collaboratively.

REFERENCE

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

CO - PO and CO - PSO MAPPING

Course Outcomes	PROGRAM OUTCOMES												PSOs			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
2	3	3	2	1	1	-	-	-	-	-		-	-	-		-
3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Avg	**3**	**2.4**	**2.6**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

1 - low, 2 – medium, 3 – high, '-' – no correlation

CHEMISTRY LABORATORY: (Any five experiments to be conducted)

OBJECTIVES

- To inculcate experimental skills to test basic understanding of water quality parameters, such as acidity, alkalinity, hardness, DO, TDS, chloride, and chlorine.
- To familiarise the students with electroanalytical techniques like conductometry and flame photometry to determine the impurities in aqueous solution.
- To find the various characteristics of domestic water.
- To understand the Pseudo first-order kinetics reaction.
- To make the students know the synthesis of nanoparticles.

LIST OF EXPERIMENTS

1. Determination of chloride content of water sample by Argentometric method.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler's method.
4. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
5. Determination of types and amount of alkalinity in water samples.
6. Estimation of available chlorine in bleaching powder solution.
7. Conductometric titration of barium chloride against sodium sulfate (Precipitation titration).
8. Estimation of sodium /potassium present in water using a flame photometer.
9. Estimation of TDS of a water sample by gravimetry.
10. Preparation of nanoparticles (Ag/Au/TiO_2/ZnO/CuO).
11. Pseudo first-order kinetics- ester hydrolysis.

TOTAL: 30 PERIODS

OUTCOMES

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

CO1: To infer the quality of water samples for alkalinity, hardness, DO, TDS, chloride, and chlorine.

CO2: To apply the knowledge on the estimation of metal ions, acidity and its

precipitation nature towards their process.

CO3: To recognize the threshold limit for various characteristics of domestic water.

CO4: To identify the simple method of synthesis of nanoparticles.

CO5: To understand the pseudo first-order kinetics reaction from ester hydrolysis.

TEXTBOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014).
2. Suchi Tiwari, Engineering Chemistry Lab Manual, Scitech Publications (India) Pvt. Ltd. (2nd Edition, 2013).
3. Pushpendra Kumar, Laboratory Manual for Engineering Chemistry, Reyansh Authortopic Pvt. Ltd., (1st Edition, 2022).

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	1	-	1	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	1	-	2	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
AVG	**3**	**2.4**	**2.6**	**1**	**1.2**	**-**	**0.2**	**-**	**-**	**-**	**-**	**0.2**	**-**	**0.4**	**-**	**-**

1 - low, 2 - medium, 3 - high, '-' - no correlation

GE3134	ENGINEERING PRACTICES LABORATORY	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes)	0	0	4	2

COURSE OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
- 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 - Study

Basic Machining:

a) Facing

b) Simple Turning

c) Step Turning

Sheet Metal Work:

a) Forming & Bending

b) Model making – Trays

Demonstration on:

a) Smithy operations, upsetting, swaging, setting down and bending.

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

c) Assembly of centrifugal pump

d) Assembly of air conditioner

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.

COURSE OUTCOMES:

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

CO1: Carry out various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering

CO2: Fabricate carpentry components and pipe connections including plumbing Works and use welding equipment's to join the structures.

CO3: Carry out the basic machining operations, make the models using sheet metalworks. Illustrate on centrifugal pump, air conditioner, operations of smithy, foundry and fittings

CO4: Carry out basic home electrical works and measure the electrical quantities

CO5: Elaborate on the electronics components, gates and 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, etc. 5 Sets
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos
5. Centre lathe 2 Nos.
6. Hearth furnace, anvil and smithy tools 2 Sets
7. Moulding table, foundry tools 2 Sets
8. Power Tool: Angle Grinder 2 Nos.
9. Study-purpose items: centrifugal pump, air-conditioner 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

CO - PO and CO - PSO MAPPING

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	-	-	-	-	1	-	-	-	-	-	1	2	-	3	-
2	-	1	2	-	3	-	-	-	-	-	1	-	-	-	2	-
3	-	-	-	3	2	-	-	-	-	-	-	1	1	-	-	2
4	-	2	3	1	2	-	-	-	-	-	-	-	-	2	-	-
5	-	3	2	2		-	-	-	1	-	-	-	2	-	-	-
AVG	**3**	**2**	**2.3**	**2**	**2.3**	**1**	**-**	**-**	**1**	**-**	**1**	**1**	**1.7**	**2**	**2.5**	**2**

1 - low, 2 – medium, 3 – high, '-' – no correlation

EN3211 PROFESSIONAL ENGLISH – II L T P C

3 0 0 3

OBJECTIVES

The course prepares the second semester Engineering students

- To develop strategies and techniques to enhance their reading skills.
- To engage them in meaningful activities in order to improve their listening, speaking, reading and writing skills.
- To improve their ability to write effective job application, resumes and draft impressive reports.
- To develop analytical thinking skills for problem solving in communicative contexts.
- To participate in group discussions.

UNIT – I: MAKING COMPARISON 9

Listening: Clippings of Ted talk, cartoon and interviews of sports personalities for listening and discussion.

Speaking: Descriptions and discussions based on newspaper.

Reading: Learning shades of meaning (using Thesaurus) and inferring the context from general passages.

Writing: Compare & Contrast essays and Jumbled Sentences.

Language and Vocabulary development: Prepositional phrases, contextual meaning of words. Verbal Analogy, Same word used as Noun and Verb.

UNIT – II: EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING 9

Listening: Anecdotes to be read from books like Chicken Soup books. Evaluative listening — Advertisement and Product description.

Speaking: Marketing a product, persuasive speech

Reading: Description of any product / jewellery, Brochures and Manual.

Writing: Formal letters- letters of complaint, appreciation, and suggestion, Comprehension and E-mail (formal)

Language and Vocabulary development: Active & Passive, Infinitive, Gerund, Purpose Statements, Adverbs and Word formation

UNIT – III: ABILITY TO PUT IDEAS OR INFORMATION COGENTLY **9**

Listening: Listen to English songs and find the lyrics/new words

Speaking: Role play and Interviews

Reading: Reading magazine articles, Excerpts from literary texts

Writing: Job Application, Resume, Cover letter, SWOC Analysis and Recommendations.

Language and Vocabulary development: Correction of errors, If conditional, Sentence completion and Connotations.

UNIT – IV: ANALYZING PROBLEMS AND EXPRESSING SOLUTIONS **9**

Listening: Watching Stand-up comedies and comprehending ideas expressed there.

Speaking: Speak about the Stand-up comedies viewed and express personal views about the same

Reading: Reading different types of books (novels, short stories, biographies, magazines etc. and speaking about the same.

Writing: Dialogue Writing, Checklist and Problem Solving essays.

Language and Vocabulary development: Reported Speech, Modals, Slogan writing and Conjunctions.

UNIT – V: REPORTING EVENTS **9**

Listening: Listening to spot errors, listening to varied dialects and accents of English.

Speaking: Group discussion- Expression of opinions, assertion, coercion etc.

Reading: Reading life experiences of common man from magazines.

Writing: Accident Report / Survey Report and Letters to the Editor.

Language and Vocabulary development: Numerical Adjective, Idioms, Vocabulary — Shades of Meaning.

TOTAL: 45 PERIODS

COURSE OUTCOME

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

CO1: To compare and contrast ideas and information from technical texts.

CO2: To incorporate basic grammar structures to express appreciation, suggestion

and complaint in writing.

CO3: To draft effective resumes using appropriate vocabulary and to avoid common errors.

CO4: To analyse problems so as to arrive at appropriate solutions and to communicate relevantly.

CO5: To draft technical reports, letters and to express ideas creatively.

TEXT BOOKS:

1. English for Science and Technology Cambridge University Press,2021. Dr.Veena Selvam, Dr.Sujatha Priyadarshini, Dr. Deep Mary Francis, Dr.K.N.Shoba and Dr.Lourdes Joevani, Department of English, Anna University.
2. Technical Communication — Principles and Practice by Meenakshi Raman & Sangeeta Sharma, Oxford Univ.Press, 2016, New Delhi.
3. Technical English for Professional — Advanced by C. Gangalakshmi, B. Rathika and L. Saranraj, Cengage Learning India Pvt. Ltd.,2022.

REFERENCES:

1. Learning to communicate – Dr. V. Chellammal, Oxford Univ.Press,2001 New Delhi.
2. Business Correspondence and Report Writing by Prof. R. C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
3. Developing Communication Skills by Krishna Mohan, Meera Bannerji-Macmillan India Ltd. 1990, Delhi.
4. Improve Your Writing ed. V.N Arora Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
5. English For Engineers and Technologists, Orient Blackswan Private Ltd. Department of English, Anna University,2020.

CO - PO and CO - PSO MAPPING

Course Outcomes	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	-	1	2	1	-	-	-	-	-	3	-	1	-	-	-	-
CO2	2	2	1	2	2	-	-	-	-	3	1	1	-	-	-	-
CO3	-	-	1	-	-	-	-	-	-	3	-	-	-	-	-	-
CO4	2	3	2	3	-	-	2	-	-	3	-	-	-	-	-	-
CO5	2	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-
AVG	**2**	**2**	**1.4**	**2**	**2**	**-**	**2**	**-**	**-**	**2.8**	**1**	**1**	**-**	**-**	**-**	**-**

1 - low, 2 – medium, 3 – high, '-' – no correlation

MA3222 STATISTICS AND NUMERICAL METHODS L T P C

3 1 0 4

OBJECTIVES:

- This course aims at providing the necessary basic concepts of statistical and Numerical Methods for solving numerically different problems of engineering and Technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and differentiation and integration in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT-I: STATISTICAL HYPOTHESIS TESTS 9L+3T

Sampling distributions - Tests for single mean and difference of means (Large and small samples) — Tests for single variance and equality of variances — Chi square test for goodness of fit — Independence of attributes.

UNIT-II: EXPERIMENTAL DESIGN FOR ANOVA 9L+3T

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design

UNIT-III: SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 9L+3T

Solution of algebraic and transcendental equations - Fixed point iteration method — Newton - Raphson method - Solution of linear system of equations - Gauss elimination method — Pivoting - Gauss Jordan method — Iterative method of Gauss Seidel — Dominant Eigenvalue of a matrix by Power method.

UNIT-IV: INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9L+3T

Lagrange's and Newton's divided difference interpolations — Newton's forward and

backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical integrations using Trapezoidal, Simpson's rules.

UNIT-V: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **9L+3T**

Single step methods: Taylor's series method - Euler's method - Modified Euler's method Fourth order Runge-Kutta method for solving first order equations - Multi step methods: Milne's and Adams -Bash forth predictor corrector methods for solving first order equations.

TOTAL: 45L+15T PERIOD

OUTCOMES:

CO1: Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO2: Apply the basic concepts of classifications design of experiments in the field of agriculture.

CO3: Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

CO4: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

CO5: Solve the ordinary differential equations with initial and boundary conditions by using certain techniques with engineering application.

TEXT BOOKS:

1. Grewal. B.S. and Grewal. J.S., "Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi,2015.
2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition,2015.

REFERENCE BOOKS:

1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning,2016.

2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald.C.F., Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia,NewDelhi,2006.

CO - PO and CO - PSO MAPPING

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

No Correlation - Low 1 Medium 2 High 3

PH3226 **MEDICAL PHYSICS** **L T P C**
3 0 0 3

(For Second Semester- B.E ECE - MDE)

OBJECTIVES

- To make the students, understand the fundamentals of Electromagnetic spectrum.
- To acquire the knowledge on radiations detection and hazards.
- To educate the concepts of light and sound in medical field.
- To provide information on radiographic imaging techniques.
- To understand and apply different nanophysics concepts in medical field.

UNIT - I: ELECTROMAGNETIC SPECTRUM AND RADIATIONS 9

Introduction-properties and classification of electromagnetic radiation-different sources of radiation-radio waves, microwaves, infrared visible, ultra violet radiation, X-rays, gamma rays - production, physical properties and their interaction with tissues.

UNIT- II: RADIATION SOURCES AND HAZARDS 9

Radiation sources: Gamma chamber - Particle accelerators — Accelerators in medical and industrial applications — safety aspects of accelerators- Radiation hazards: evaluation, control and radiation protection- detection and measurement of contamination on work surface and person - methods of decontamination – planning of medical and industrial radiation installations-radiation scattering-albedo-sky shine.

UNIT- III: MEDIPHOTONICS AND MEDICAL ULTRASOUND 9

Lasers in medicine - applications of ultrafast pulsed lasers - lasers in dermatology - oncology and cell biology - lasers in blood flow measurement - ultrasound production- Bioacoustics-acoustical characteristics of human body - ultrasonic dosimetry- destructive and non-destructive tests - high power ultrasound in therapy.

UNIT- IV: PHYSICS OF MEDICAL RADIOGRAPHY 9

Physics of X-ray production- endoscopes - nuclear imaging techniques- nanotech based imaging techniques: Magnetic resonance imaging (MRI) - Computed tomography (CT) - Positron emission tomography (PET) - Single photon emission computed tomography (SPECT)- Fluorescence imaging.

UNIT- V: NANOPHYSICS IN BIOMEDICAL APPLICATIONS 9

Molecular Engineering - Nanoscale structures as Biological tags - nanoparticles and microorganisms - nano materials in bone substitutes and dentistry- metallic, ceramic and polymeric implant materials — nanoparticles in cosmetics - drug delivery and applications.

TOTAL: 45 PERIODS

OUTCOMES:

After the completion of the course, students should be able

CO1: To understand the Electromagnetic spectrum and its applications.

CO2: To get an idea of radiation sources and its hazards and control of radiation.

CO3: To differentiate the various applications of lasers and ultrasonic in medicine.

CO4 : To know the importance of various imaging techniques.

CO5 : To apply the nanophysics in biomedical applications.

TEXT BOOKS:

1. B.N.Sankar,S.O.Pillai, " A text book of Engineering Physics", New Age International (P) Limited, 2007.
2. S.Webb, "The Physics of Medical Imaging", "Taylor and Francis,Newyork, London,2010.
3. A.K.JHA, "A text book of Applied Physics", IK International Publishing house, 2011.
4. Knoll GF, "Radiation Detection and Measurements", Wiley, New York, 1989.

REFERENCE BOOKS:

1. Charles P. Poole Jr., Frank J. Ownes, 'Introduction to Nanotechnology", Wiley Interscience, 2003.
2. R.Pratesi and C.A.Sacchi, Lasers in photo medicine and photobiology, Springer Verlag, West Germany,1980.
3. J.P. Woodcock, Ultrasonic, Medical Physics Handbook Series I, Adam Higher, Bristor, 2002.
4. Hannah Sathyaseelan, "Textbook of Applied Physics", New Age International (P) Limited, 2000.

E-BOOKS:

1. J.R.Greening, Medical Physics, North Holland Publishing Co., Newyork,1999.
2. E.B.Podgarsak, Radiation Physics for Medical Physicists, Springer Verlag, 1st Edition (1996).

CO - PO and CO - PSO MAPPING

Course Outcomes	PROGRAM OUTCOMES												PSOs			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	-	1	-	-	-	-	-	-	-	1	-	-	-	-
CO2	2	1	1	1	1	2	1	-	-	-	-	1	-	-	-	-
CO3	3	2	2	2	2	1	1	-	-	-	-	1	-	-	-	-
CO4	3	2	2	2	2	1	1	-	-	-	-	1	-	-	-	-
CO5	1	1	1	-	-	2	1	-	-	-	-	1	-	-	-	-
Avg	**2.4**	**1.6**	**1.5**	**1.5**	**1.6**	**1.5**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**

1 - low, 2 – medium, 3 – high, '-' – no correlation

CH3226 CHEMISTRY FOR BIO-MEDICAL ENGINEERING L T P C

(Second Semester-B.E., Medical Electronics) **3 0 0 3**

OBJECTIVES

- To familiarize the students with the structure and role of carbohydrates, lipids and proteins.
- To impact the knowledge of the molecular structure, function and organization of nucleic acids, vitamins and enzymes.
- To introduce various materials used in bone and joint replacement.
- To know about dental materials and dental implants.
- To introduce the basic knowledge of the importance of spectroscopy and biosensors.

UNIT-I CARBOHYDRATES, LIPIDS, AND PROTEINS 9

Carbohydrates, lipids, fat, amino acids, proteins: types, structure, physical and chemical properties. Nucleic acid: structural aspects - components of DNA and RNA, nucleosides & nucleotides (introduction, structure & bonding), double helical structure of DNA (Watson-Crick model).

UNIT-II VITAMINS AND CO-ENZYMES 9

Vitamins: structure, importance and stability, water-soluble vitamins, Fat-soluble vitamins. Enzymes & co-enzymes: classification, characteristics and mechanism of action (Lock and key, Induced fit), enzyme specificity, enzyme inhibitors, drugs inhibiting enzyme activity, and medical uses.

UNIT- III ORTHOPAEDIC MATERIALS 9

Bone composition and properties - temporary fixation devices - joint replacement - biomaterials used in bone and joint replacement: metals and alloys - stainless steel, cobalt-based alloys, titanium-based materials - ceramics: carbon, alumina, zirconia, bioactive calcium phosphates, bioglass and glass ceramics - polymers: PMMA, UHMWPE/HDPE, PTFE - bone cement - composites.

UNIT-IV DENTAL MATERIALS 9

Teeth composition and mechanical properties - impression materials - bases, liners and varnishes for cavities - fillings and restoration materials - materials for oral and maxillofacial surgery - dental cements and dental amalgams - dental adhesives.

UNIT- V SPECTROSCOPY AND BIOSENSORS 9

Introduction, absorption of radiation, types of spectra, UV-Visible, IR and fluorescence spectrophotometer: Instrumentation and applications. Biosensors: Classification (biochemical sensors), antibody, antigen, peptide, ECG sensor, gyroscope, glucometer, pulse oximeter, biometrics, biochips - applications.

OUTCOMES

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

CO1: To identify the structure, physical and chemical properties of carbohydrates, lipids and proteins.

CO2: To infer an understanding of the basic concepts of vitamins and enzyme activity and also medical uses of enzymes.

CO3: To know and prepare various materials used in bone and joint replacement and their applications.

CO4: To prepare impression materials and dental cements, and know about dental implants.

CO5: To recognize the concepts of spectroscopic techniques for structural determination and biosensors.

TEXTBOOKS

1. Jain P.C. and Monica Jain, “Engineering Chemistry”, Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2019.
2. Donald Voet & Judith G. Voet, “Biochemistry” 4th Edition, John Wiley and Sons Publication, 2010.
3. Veena K. Subbarao, Koteswararao Pachava, “Dental Materials” 7th Edition, Paras Medical Publisher, 2020.

REFERENCES

1. S. S. Dara and S. S. Umare, “A Text Book of Engineering Chemistry”, 12th Edition, S. Chand & Company LTD, New Delhi, 2018.
2. B. Sivasankar, “Engineering Chemistry”, Tata McGraw-Hill Publishing Company LTD, 2023.
3. B.D.Ratner, A.S.Hoffman, F.J.Schoen & J.E.Lemons. “Biomaterials Science: An Introduction to Materials in Medicine”, Academic Press, 2004.
4. Q. Chen and G. Thouas. Biomaterials. A Basic Introduction. CRC Press, 2015.

CO - PO and CO - PSO MAPPING

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	2	2	1	1	-	-	-	-	1	1	-	-	-
CO4	3	3	2	2	2	1	1	-	-	-	-	1	1	-	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	1	1	1	-
AVG	**2.6**	**2.6**	**2.4**	**1.8**	**1.8**	**0.4**	**0.2**	**-**	**-**	**-**	**-**	**0.4**	**0.6**	**0.8**	**0.2**	**-**

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

GE3231 PROBLEM SOLVING AND PYTHON PROGRAMMING L T P C

(Common to All branches) 3 0 0 3

OBJECTIVES:

- To know the basics of Python programming
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures and its implementation – lists, tuples, dictionaries.
- To understand Object Oriented Concept in Python.

UNIT I: PYTHON BASICS 9

Introduction to Python — Literals — Variables and Identiiers — Data Types — Input Operation — Comments — Reserved words — Indentation — Operators and Expressions — Modes of python. Conditionals: Boolean values and operators - conditional if - alternative if - chained conditional - Iteration, Illustrative programs: Basic Arithmetic Operations, GCD of numbers, Square root (Newton's Method).

UNIT II FUNCTIONS, LIST, TUPLES 9

Functions, function definition and use. **Fruitful functions:** return values, parameters, local and global scope, recursion. **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: exchange the values of two variables, square root, Linear and Binary search. Fibonacci series using functions.

UNIT III STRINGS, DICTIONARY, 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). Illustrative programs: creates a dictionary of radius of a circle and its circumference.

UNIT IV FILES, EXCEPTIONS, MODULES AND PACKAGES 9

Files and exception: Text Files, Reading and Writing files, Format operator; Errors and Exceptions, Handling Exceptions, Multiple Except blocks, Modules, Packages;

Illustrative programs: word count, copy file, Creating user defined Exceptions.

UNIT V CLASSES AND OBJECTS 9

Classes and Objects: Introduction, Classes and Objects, Defining Classes, Creating Objects, Data Abstraction and Hiding, The Class Method and Self Argument, The _init_( ) method, Class Variables and Object Variables, Public and Private data members, Private Methods. Illustrative Programs: Creating Student Class and Objects.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Develop simple computational problems using control flow statements.

CO2: Decompose a Python program into functions, Modules and Packages.

CO3: Represent compound data using Python lists, tuples, Strings, Set and dictionaries.

CO4: Read and write data from/to files and Exception handling in Python Programs.

CO5: Understand the concepts of Object-Oriented Programming to develop real time applications.

TEXT BOOKS:

1. Reema Thareja, **"Python Programming using Problem solving Approach",** Oxford Higher Education,2018.
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.

WEB REFERENCES:

1. http://greenteapress.com/wp/think-python/
2. www.docs.python.org
3. https://nptel.ac.in/courses/106/106/106106182/

CO's	PO's												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	2	-	-	-	-	-	2	2	2	-		1
2	3	3	3	3	2	-	-	-	-	-	2	2	-	-	3	-
3	3	3	3	3	2	-	-	-	-	-	2	-	-	-	1	-
4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	2	-
5	1	2	-	-	1	-	-	-	-	-	1	-	-	-	-	1
AVg.	**2.4**	**2.6**	**3**	**2.8**	**1.8**	-	-	-	-	-	**1.6**	**2**	**2.5**	-	**2**	**1**

GE3211 தமிழருமம் மதொழில்நுட்பமுமம் L T P C

1 0 0 1

அலகு I **மநசவ மற்றும் பொறனத் மதொழில்நுட்பம் :** **3**

ெங்க கொலத்தில் மநெவுத் மதொழில் – பொமனத் மதொழில்நுட்பமம் – கருப்பு சிவப்பு பொண்டங்கள் – பொண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவறமப்பு மற்றும் கட்டிடத் மதொழில்நுட்பம் 3

ெங்க கொலத்தில் வடிவமமப்பு மற்றுமம் கட்டுமமொனங்கள் & ெங்க கொலத்தில் வீட்டுப் மபொருட்களில் வடிவமமப்பு. ெங்க கொலத்தில் கட்டுமமொன மபொருட்களுமம் நடுகல்லுமம் – சிலப்பதிகொரத்தில் மமமட அமமப்பு பற்றிய விவரங்கள் — மமொமல்லபுரெ் சிற்பங்களுமம், மகொவில்களுமம் – மொழர் கொலத்Fப் மபருங்மகொயில்கள் மற்றுமம் பிற வழிபொட்டுத் தலங்கள் – நொயக்கர் கொலக் மகொயில்கள் – மமொதிரி கட்டமமப்புகள் பற்றி அறிதல், மFமர மீனொட்சி அம்மன் ஆலயமம் மற்றுமம் திருமமல நொயக்கர் மஹொல் — மெட்டிநொட்டு வீடுகள் — பிரிட்டிஷ் கொலத்தில் மென்மனயில் இந்மதொ – ெமொமரொமெனிக் கட்டிடக் கமல.

அலகு III உற்பத்தித் மதொழில்நுட்பம் : 3

கப்பல் கட்டுமம் கமல – உமலொகவியல் – இருமம்புத் மதொழிற்ெமொமல – இருமம்மப உருக்குதல், எஃகு – வரலொற்றுெ் ெமொன்றுகளொகெ் மெமம்பு மற்றுமம் தங்க நொணயங்கள் — நொணயங்கள் அெமொடித்தல் — மணி உருவொக்குமம் மதொழிற்ெமொமலகள் – கல்மணிகள், கண்ணொடி மணிகள் – சுடுமண் மணிகள் — ெங்கு மணிகள் — எலுமம்புத்Fண்டுகள் — மதொல்லியல் ெமொன்றுகள் – சிலப்பதிகொரத்தில் மணிகளின் வமகைள்.

அலகு IV கவளொை்றம மற்றும் நீர்ப்பொசனத் மதொழில்நுட்பம் : 3

அமண, ஏரி, குளங்கள், மதகு — மொழர்கொலக் குமுழித் தூமம்பின் முக்கியத்Fவமம் – கொல்நமட பரொமரிப்பு – கொல்நமடகளுக்கொக வடிவமமக்கப்பட்ட கிணறுகள் – மவளொண்மம மற்றுமம்

மவளொண்மமெ்ொர்ந்த மெயல்பொடுகள் – கடல்ெொர் அறிவு – மீன்வளமம் – முத்F மற்றுமம் முத்Fக்குளித்தல் – மபருங்கடல் குறித்த பண்மடய அறிவு – அறிவுெொர்
ெமூகமம்.

அலகு V அறிவியல் தமிழ் மற்றும் கைித்தமிழ் : 3

அறிவியல் தமிழின் வளர்ெ்சி — கணித்தமிழ் வளர்ெ்சி — தமிழ் நூல்கமள மின்பதிப்பு மெய்தல் – தமிழ் மமன்மபொருட்கள் உருவொக்கமம் — தமிழ் இமணயக் கல்விக்கழகமம் — தமிழ் மின் நூலகமம் — இமணயத்தில் தமிழ் அகரொதிகள் – மொற்குமவத் திட்டமம்.

TOTAL : 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

1. தமிழக வரலொறு — மக்களுமம் பண்பொடுமம் — மக.மக. பிள்மள (மவளியீடு : தமிழ்நொடு பொடநூல் மற்றுமம் கல்வியியல் பணிகள் கழகமம்).

2. கணினித் தமிழ் – முமனவர் இல. சுந்தரமம். (விகடன் பிரசுரமம்).

3. கீழடி / மவமக நதிக்கமரயில் ெங்ககொல நகர நொகரிகமம் (மதொல்லியல் Fமற மவளியீடு)

4. மபொருமந — ஆற்றங்கமர நொகரிகமம். (மதொல்லியல் Fமற மவளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL — (in print)

6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by : International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)

9. Keeladi — ‘Sangam City Civilization on the banks of river Vaigal’ (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by : The Author)
11. Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) – Reference Book.

GE3211 TAMILS AND TECHNOLOGY L T P C

1 0 0 1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in hous ehold materials during Sangam Age – Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram — Sculptures and Temples of Mamallapuram – Great Temples of Cholas and other worship places – Temples of Nayaka Priod — Type study (Madurai Meenakshi Temple) — Thirumalai Nayakar Mahal – Chetti Nadu Houses, Indo – Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building — Metallurgical studies — Iron industry — Iron smelting, steel — Copper and gold – Coins as source of history – Minting of Coins – Beads making – Industries Stone beads — Glass beads — Terracotta beads — Shell beads / bone beats – Archeological evidences – Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Perio, Animal Husbandry — Wells designed for cattle use — Agriculture and Agro Processing — Knowledge of Sea — Fisheries — Pearl — Conche diving — Ancient Knowledge of Ocean – Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil – Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

1. தமிழக வரலொறு — மக்களுமம் பண்பொடுமம் — மக.மக. பிள்மள (மவளியீடு : தமிழ்நொடு பொடநூல் மற்றுமம் கல்வியியல் பணிகள் கழகமம்).

2. கணினித் தமிழ் – முமனவர் இல. சுந்தரமம். (விகடன் பிரசுரமம்).
3. கீழடி / மவமக நதிக்கமரயில் ெங்ககொல நகர நொகரிகமம் (மதொல்லியல் Fமற மவளியீடு)
4. மபொருமந — ஆற்றங்கமர நொகரிகமம். (மதொல்லியல் Fமற மவளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL — (in print)
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by : International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by : International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by : International Institute of Tamil Studies.)
9. Keeladi — 'Sangam City Civilization on the banks of river Vaigal' (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by : The Author)
11. Porunai Civilization (Jointly Published by : Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by : RMRL) – Reference Book.

GE3233 ENGINEERING GRAPHICS AND DESIGN L T P C

(Common to all branches of B.E. / B.Tech. Programmes) 1 0 4 3

OBJECTIVES:

The main learning objective of this course is to impart knowledge

1. To draw the conics curves & special curves, use BIS conventions, and specifications for engineering drawing.
2. To draw the orthographic projection of lines and plane surfaces.
3. To draw the projections and solids and Isometric projection of simple solids.
4. To draw the projections and solids and Isometric projection of simple solids.
5. To draw free hand sketching of basic geometrical constructions, multiple views of objects and Perspective Projection of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

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

UNIT-I: PLANE CURVES AND SPECIAL CURVES 11

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 12

Orthographic projection- Principles-Principal planes - First angle projection-projection of points at the 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 12

Projection of simple solids like prisms, pyramids, cylinders and cones when the axis is inclined to one of the principal planes by the rotating object method. Principles of isometric projection — isometric scale — Isometric projections of **simple solids -**

Prisms, pyramids, cylinders, cones - isometric view of the object from the 2D coded plan.

UNIT-IV: PROJECTION OF SECTIONED SOLIDS & DEVELOPMENT OF SURFACES 12

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

UNIT-V: FREE-HAND SKETCHING AND PERSPECTIVE PROJECTIONS 12

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: 60 PERIODS

COURSE OUTCOMES:

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

CO1: To construct the conics curves & special curves, use BIS conventions, and specifications for engineering drawing.

CO2: To construct the orthographic projection of lines and plane surfaces.

CO3: To construct the projections and solids and Isometric projection of simple solids.

CO4: To construct projections of section of solids and development of surfaces.

CO5: To construct 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 2019 (Fifth Reprint)
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 15th Edition 2018.

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. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2011.
5. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.

Publication of Bureau of Indian Standards:

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

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scales to fit solutions within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

CO’s- PO’s & PSO’s MAPPING

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

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

GE3221 **ENGINEERING SCIENCES LABORATORY** **L T P C**

(First Semester- Common to all branches) **0 0 4 2**

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

PHYSICS LABORATORY: (Any five experiments to be conducted)

OBJECTIVES:

- To gain practical knowledge and to co-relate with the theoretical studies.
- To achieve perfectness in experimental skills and the study of practical applications.
- To bring more confidence and ability to develop and fabricate engineering and technical equipment.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS

1. Determination of the electrical conductivity of metals by plotting a current-voltage characteristic curve.
2. Determination of band gap of a semiconductor.
3. Determination of Fermi energy. (Measurement of Fermi energy in copper).
4. Study of I-V characteristics of solar cell and determination of its efficiency
5. Determination of electrical resistivity of metal and alloy –Carey foster Bridge.
6. Measurement of susceptibility of paramagnetic solution by Quinke's method.
7. Study of magnetic Hysteresis-B-H curve.
8. Determination of the dark resistance of light detective resister (LDR).
9. Measurement of Temperature using LM35.

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, the students should be able

CO1: To understand the functioning of various physics laboratory equipment.

CO2: To use graphical models to analyze the laboratory data and to solve problems individually and collaboratively.

CO3: Use mathematical models as a medium for quantitative reasoning and describing physical reality.

CO4: Access, process and analyze scientific information.

CO5: Solve problems individually and collaboratively.

TEXTBOOKS:

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

CO's- PO's & PSO's MAPPING

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-		-	-	-		-
CO3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
AVG	**3**	**2.4**	**2.6**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

CHEMISTRY LABORATORY: (Any five experiments to be conducted)

OBJECTIVES

- To train the students in basic experimental skills in water contaminants such as copper and chromium.
- To familiarise the students with electroanalytical techniques such as pH metry, potentiometry, and conductometry to determine impurities in aqueous solutions.
- To familiarize the students with the determination of the molecular weight of a polymer by a viscometer.

- To make the student up-to-date with the properties and nature of alloys experimentally.
- To demonstrate the analysis of coal.

LIST OF EXPERIMENTS:

1. Estimation of copper content of the given solution by Iodometry.
2. Determination of strength and amount of acids in a mixture of acids using a conductivity meter.
3. Determination of strength and amount of HCl present in the whole of the given solution using a conductivity meter.
4. Estimation of the iron content of the given solution using a potentiometer.
5. Determination of chromium by EDTA titration.
6. Determination of strength of given hydrochloric acid using a pH meter.
7. Determine the molecular weight of the polyvinyl alcohol using an Ostwald viscometer.
8. Estimation of Nickel in steel.
9. Proximate Analysis of Coal.
10. Corrosion experiment-weight loss method.
11. Determination of COD value of industrial effluents.

TOTAL: 30 PERIODS

OUTCOMES

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

CO1: To find the quality of water samples for copper and chromium present in water.

CO2: To recognize the amount of various ions present in the water sample through volumetric and instrumentation techniques.

CO3: To identify the molecular weight of the polymer using an Ostwald viscometer.

CO4: To recognize an environmental hazardous and threshold limit for industrial effluents.

CO5: To recommend quality of coal and steel when it is exposed to various environment.

TEXT BOOKS

1. Vogel's Textbook of Quantitative Chemical Analysis (8th Edition, 2014).
2. Suchi Tiwari, Engineering Chemistry Lab Manual, Scitech Publications (India) Pvt. Ltd. (2nd Edition, 2013).
3. Pushpendra Kumar, Laboratory Manual for Engineering Chemistry, Reyansh Authortopic Pvt. Ltd., (1st Edition, 2022).

CO's- PO's & PSO's MAPPING

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	1	1	1	-	1	-	-	-	-	-	-	-	-	-
CO2	2	2	1	1	1	-	-	-	-	-	-	-	-	2	-	-
CO3	2	1	1	1	2	-	-	-	-	-	-	-	-	-	-	-
CO4	2	2	1	1	1	2	2	2	-	-	-	-	-	-	-	-
CO5	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
AVG	2	1.4	1	1	1.2	0.4	0.6	0.4	-	-	-	-	-	0.4	-	-

1 - low, 2 - medium, 3 - high, '-' - no correlation

GE3232 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY **L T P C 0 0 4 2**

COURSE OBJECTIVES:

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

LIST OF PROGRAMS

1. Compute the GCD of two numbers.
2. Find the square root of a number. (Newton's method)
3. Find exponentiation of a number. (power of a number)
4. Find the maximum of a list of numbers.
5. Program for basic calculator operations using functions.
6. Generate Fibonacci series using function.
7. Program for Armstrong number.
8. Program for check the number is Palindrome or Not.
9. Program for sum of array of numbers.
10. How to create, slice, change, add, delete and index elements using list.
11. Linear search and Binary search.
12. Find First n prime numbers.
13. Program to remove duplicate elements from a list.
14. Program for addition and transpose of a matrix.
15. How to create, slice, change, delete and index elements using Tuple.
16. Write a program to reverse the string.
17. How to change, delete, add and remove elements in Dictionary.
18. Create a dictionary of radius of circle and its circumference.
19. Program for count the number of words in a file.
20. Find the most frequent words in a text read from a file.
21. Program for student information system using class and objects.
22. Program for Employee Payroll Processing using class and objects.

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: Develop solutions to simple computational problems using Python programs.

CO2: Solve problems using conditionals and loops in Python.

CO3: Develop Python programs by defining functions and calling them.

CO4: Use Python lists, tuples and dictionaries for representing compound data.

CO5: Develop Python programs using files and OOPS concept.

CO's- PO's & PSO's MAPPING

CO's	PO's												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	3	-	-	-	-	-	3	2	1	3		
2	3	3	3	3	3	-	-	-	-	-	3	2			2	
3	3	3	3	3	2	-	-	-	-	-	2	-		3		2
4	3	2	-	2	2	-	-	-	-	-	1	-			1	
5	1	2	-	-	1	-	-	-	-	-	1	-	1		2	2
6	2	-	-	-	2	-	-	-	-	-	1	-	1		1	
AVG	2.6	2.6	3	2.8	2.2	-	-	-	-	-	2	2	1	3	1.7	2

GE3251 NSS/YRC/NSO/CLUB ACTIVITIES	L	T	P	C
	0	0	0	0

Unit – 1 : NATIONAL SERVICE SCHEME (NSS)

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

Credit:

Total Lecture Hours / Semester	Total Tutorial Hours / Semester	Total Practical Hours / Semester	Credit
6	0	18	1*

* To be conducted after college hours and week ends

Outcome:

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

Syllabus:

Semester : I&II Attendance weightage : 50 Activities weightage : 50

Topic -I :Introduction and Basic Concepts of NSS [8]

a. History – Aim – Objectives of NSS

b. Emblem – Motto – Badge - Song

c. Organizational structure - Roles and Responsibilities of NSS

d. Regular activities

e. Any approved indoor / outdoor programs by the Principal

Topic-II : Youth Leadership, Social Harmony and National Integration[8]

a. Meaning and types of Leadership

b. Qualities of good leaders and leadership

c. Importance and role of youth leadership

d. Role of youth in peace and Nation building

e. Any approved indoor / outdoor programs by the Principal

Topic-III :Health, Hygiene and Sanitation and Youth Health [8]

a. Definition, Needs and Scope of Health Education

b. Swachh Bharat Abhiyan

c. Healthy Lifestyles

d. HIV, AIDS, Drugs abuse

e. Any approved indoor / outdoor programs by the Principal

Topic-IV :Environment Issues, Emergencies and Disaster Management [8]

a. Environment conservation, enrichment and sustainability

b. Waste management

c. Natural resource management [Rain water harvesting and Energy conservation]
d. Introduction to Disaster Management, Classification of Disasters
e. Any approved indoor / outdoor programs by the Principal

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/

NSS/NSO/YRC/CLUB ACTIVITIES

YOUTH RED CROSS – Social Service based activities

OBJECTIVES:

- To enhance the societal awareness
- To upgrade the Personality

ACTIVITIES **5**

1. **HEALTH PROMOTION**- Activities that promotes health (2)
2. **SOCIETAL SERVICE**-Social Service activities (2)
3. **FRIENDSHIP BUILDING** - Friendship building activities between communities (1)

COURSE OUTCOME

1. Enhanced Social Awareness
2. Personality development of the individual

References:

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

NSS/NCC/NSO/YRC/CLUB ACTIVITIES

National Sports Organization (NSO)

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 responsibilities and social interaction through participation

ACTIVITIES **5**

INTRODUCTION - Introduction of NSO & Physical Fitness and games Skills Test (1)

PHYSICAL FITNESS ACTIVITIES - Importance of Basic Physical Fitness - MDI Calculation - Identification of deformities, (2)

SPORTS PRACTICE - Games and fitness activities Physical Fitness Activities (2)

COURSE OUTCOMES:

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

REFERENCES:

1. www.google.com
2. https://scholar.google.com/
3. https://www.medindia.net/patients/lifestyleandwellness/five-essential-components-of-physical-fitness-references.htm
4. https://pubmed.ncbi.nlm.nih.gov/

NSS/NSO/YRC/CLUB ACTIVITIES

தமிழ் மன்றம்

பொடத்திட்டத்தின் மநொக்கங்கள்

- மொணவர்கமள சிறந்த மமமடப்மபெ்ொளர்களொக உருவொக்குவF
- தொய்மமொழியின் மமன்மமமய பொFகொப்பF..

பயிற்சித்திட்டம்

1. மபெ்சுக்கமலப் பயிற்சி
2. கவிமத மற்றும் கட்டுமரகள் எழுFம் பயிற்சி
3. அறிவியல் மபொறியியல் மதொழில்நுட்பங்கமளத் தமிழில் எழுFதல்.
4. பட்டிமன்ற மமமடகளில் மபசும் பயிற்சி.
5. நாட்டுப்புறப்பாடல்கள் பொடுதல் மற்றும் கமதகள் எழுFம் பயிற்சி.

கற்றல் முடிவு

1. மபெ்சுக்கமலப் தேர்ச்சி
2. நாட்டுப்புறப்பாடல்கள் பற்றிய புரிதல்

மமற்மகொள்கள்

1. https://eegarai.darkbb.com/t63483-topic
2. https://poriyari.in/

NSS/NSO/YRC/CLUB ACTIVITIES

RESONANCE – SKILL BASED ACTIVITIES

OBJECTIVES:

- To know the basics and general principles of Physics.
- To provide knowledge of the current trends in Physics.
- To develop a solid scientific and technical competence for investigating and applying the relationships of Physics phenomena in *various fields of Physics.*

ACTIVITIES **5**

1. **QUIZ -** Basics and general principle (1)
2. **PAPER PRESENTATION -** Current trends (2)
3. **PROJECTS -** Fun with Physics (2)

COURSE OUTCOME

Students were able to:

- recollect the general principles of Physics.
- to explore the topics in the current trends in Physics.
- *develop practical expertise in various areas of Physics.*

REFERENCES:

1. Principles of Physics, 10Ed, Isv by Robert Resnick Jearl Walker, David Halliday (2015)
2. 'The Feynman Lectures on Physics' (Volume I, II and III) , Matthew Sands, Richard Feynman, and Robert B. Leighton.
3. https://www.science-sparks.com/top-5-physics-experiments-you-can-try-at-home
4. https://www.electronicsforu.com/category/electronics-projects/hardware-diy.

NSS/NCC/NSO/YRC/CLUB ACTIVITIES

Eclectic Lingua – Skill based activities

OBJECTIVES:

- To enhance the communicative competence of the first-year engineering students by means of creating opportunity for impromptu/ /spontaneous speeches.
- To upgrade the English language skills of students by introducing appropriate vocabulary in different situations.

ACTIVITIES **5**

1. **Extempore**- Giving expression to thoughts (2)
2. **Building Vocabulary**-Using relevant set of words for different contexts (2)
3. **Pronunciation**- Speaking accurately and fluently (1)

COURSE OUTCOME

1. To enable students to express themselves easily and coherently.
2. To help students to speak the language using the right words and pronouncing them correctly.

References

https://www.cambridgeenglish.org/learning-english/activities-for-learners/?skill=pronunciation

https://www.quillsandquotes.ca/post/12-fun-games-to-get-students-public-speaking

NSS/NCC/NSO/YRC /CLUB ACTIVITIES

EULER.COM – Skill based activities

OBJECTIVES:

- To enhance the Logical reasoning of the first-year engineering students by means of creating opportunity to improve the aptitude skill.
- To explore the applications of Mathematics in the field of Engineering, Science and Technology and to utilize this skill for their academic activities.

ACTIVITIES **5**

1. OLYMPIAD- The students will be provided with 25 questions in Engineering Mathematics. This should be completed in one hour. **(1)**

2. MATHEMATICAL MODELLING- The students are expected to present physical models (Working as well as static models) based on the application of Engineering Mathematics **(2)**

3. PAPER PRESENTATION- Students will be provided 5-7 minutes of time to present their findings in application of Mathematics. **(2)**

COURSE OUTCOME

1. To enable students to explore their mathematical reasoning skills.
2. To motivate the students to apply Mathematics in Engineering and Technology and demonstrate their work by means of Physical model and present their research article.

References:

1. Advanced Engineering Mathematics , Erwin Kreyszig, 10th Edition, Wiely India Pvt Ltd.
2. https://www.stewartcalculus.com/

NSS/NCC/NSO/YRC/CLUB ACTIVITIES

Fine Arts Club VECTORIANS – Skill based activities

OBJECTIVES:

- To enhance the inbuilt talents in arts and crafts and fine arts activities.
- To explore and exhibit theirs qualities in cultural activities as well as in the leadership.

ACTIVITIES **5**

1. **ARTS & CRAFTS** - The students will be given with innovative Theme, they have to Show their talents in one hour time with basic facilities provided. **(1)**

2. **SINGING & DANCING** - The students are expected to present their talents on spot or With given Theme, either solo or group performance. **(2)**

3. MIME & DRAMA - Students will be given 5 - 7 minutes of time to present their variety Entertainments in way of Mono acting or Drama . **(2)**

COURSE OUTCOME

1. To enable students to explore their inbuilt talents in fine arts activities.
2. To motivate the students to show case their cultural and leadership qualities.

References:

1. https://www.youtube.com/watch?v=1mkESRWiSKc – Teach your own crafts.
2. https://www.youtube.com/watch?v=YHqwrDGywH4 – How to teach Arts & Crafts

NSS/NCC/NSO/YRC/CLUB ACTIVITIES

Catalysis – Skill-based activities

Objectives:

- To inculcate a scientific attitude and temper.
- To provide an opportunity to develop constructive, explorative & inventive ideas among the students.
- To develop training in the scientific method of problem-solving for engineering

1. **Quiz/debate**- the latest advancement in Chemistry towards engineering (2)
2. **Essay competition/Chart preparation** - Environmental sustainability (2)
3. **Nature Study - field visit to eco-parks etc.** (1)

COURSE OUTCOME

1. To promote inquisitiveness among the students and inculcate Scientific mind mapping.
2. To develop students, interest and participation in the practical applications of the knowledge related to environmental sciences.
3. Take part in practical, hands-on science activities close to nature.

REFERENCE

1. M. Senapati, Advanced Engineering Chemistry, Infinity science press, New Delhi, 2007.
2. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/environmental-sustainability
3. https://www.indiabix.com/general-knowledge/chemistry.

MA3321 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS **LT P C**

3 0 0 3

OBJECTIVES:

- To introduce the effective mathematical tools for the solutions of partial differential equations.
- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To model several physical problems to develop Z transform techniques for discrete time systems.

UNIT-I: PARTIAL DIFFERENTIAL EQUATIONS 9L

Solutions Lagrange's linear equation — linear partial differential equations of second and higher order with constant coefficients of homogeneous type.

UNIT-II: FOURIER SERIES 9L

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

UNIT-III: LAPLACE TRANSFORMS 9L

Existence conditions – Transforms of elementary functions – Basic properties – Inverse transforms – Convolution theorem – Transform of periodic functions.

UNIT-IV: FOURIER TRANSFORMS 9L

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

Z- Transforms — Elementary properties — Inverse Z — transform (using partial fraction and residues) – Solution of difference equations using Z – transform.

TOTAL: 45L PERIODS

OUTCOMES:

CO1: Understand the fundamental concept of the concepts of Partial differential Equations.

CO2: Understand the basic concepts of mathematical principles on Fourier & Z-transforms.

CO3: Laplace transform and inverse transform of simple functions, properties, are studied.

CO4: Apply the concept of Understand the concept Fourier series and apply the concept in solving PDE.

CO5: 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., Manicavachagom Pillay.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**
CO1	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO2	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO3	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO4	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO5	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
Avg	**3**	**3**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**

No Correlation - Low 1 Medium 2 High 3

EC3363	SIGNALS AND SYSTEMS	L T P C
		3 0 0 3

OBJECTIVES:

- To understand the basic properties of Signals and Systems.
- To explore the Fourier transform and Laplace transform in continuous time signal analysis.
- To analyze continuous time LTI systems using Fourier and Laplace transforms.
- To apply DTFT and Z-transform in discrete time signal analysis.
- To analyze the discrete time LTI systems using DTFT and Z transform.
- To examine convolution operation for continuous and discrete time systems.

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 : 45 PERIODS

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Emphasizing the basic properties of signals and systems used for signal Processing

CO2: Characterizing the Continuous time signal using Fourier and Laplace transform.

CO3: Analyzing the Continuous time LTI systems using Fourier and Laplace transforms.

CO4: Compute the output of a Discrete time LTI system in the time and frequency domains.

CO5: Estimating the DTFT and Z transform in discrete time signal analysis.

CO6: Understanding the principles of convolution for Continuous and discrete time systems.

TEXTBOOKS:

1. Simon Haykin, Adaptive Filter Theory, Pearson Prentice Hall, 5th edition, 2014
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon, Statistical and Adaptive Signal Processing, Artech House Publishers, 2005.

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. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

COs	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	3	-	3	-	3	2	-	-	-	-	-	3	-	-	1	-
CO2	3	-	3	-	-	2	-	-	-	-	-	3	-	3	-	-
CO3	3	3	-	-	3	2	-	-	-	-	-	3	2	-	-	-
CO4	3	3	-	-	3	2	-	-	-	-	-	3	-	3	1	-
CO5	3	3	3	3	3	2	-	-	-	-	-	3	-	3	1	-
CO6	3	3	3	3	-	2	-	-	-	-	-	3	2	3	1	-
Avg	**3**	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**1**	**-**

1 - low, 2 – medium, 3 – high, '-' – no correlation

EE3363	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce electric circuits and its analysis
- To impart knowledge on solving circuit equations using network theorems
- To educate the transient response of circuits.
- To introduce the phenomenon of resonance in coupled circuits.
- To introduce Phasor diagrams and analysis of single &three phase circuits

UNIT-I BASIC CIRCUITS ANALYSIS 9

Ohm's Law -Kirchhoff 's Laws – DC Circuits – Resistors in series and parallel circuits - A.C Circuits — Average and RMS Value –Complex Impedance — Phasor diagram - Real and Reactive Power, Power Factor, Energy -Mesh current and node voltage methods of analysis D.C and A.C Circuits

UNIT-II NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUITS 9

Network reduction: voltage and current division, source transformation – star delta conversion. Theorems — Superposition, Thevenin's and Norton's Theorem — Maximum power transfer theorem –Reciprocity Theorem – Millman's theorem.

UNIT-III TRANSIENT RESPONSE ANALYSIS 9

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input –Characterization of two port networks in terms of Z, Y and h parameters.

UNIT-IV THREE PHASE CIRCUITS 9

Three phase balanced / unbalanced voltage sources –analysis of three phase 3-wire and 4-wirecircuits with star and delta connected loads, balanced &un balanced — phasor diagram of voltages and currents –power and power factor measurements in three phase circuits.

UNIT-V RESONANCE AND COUPLED CIRCUITS 9

Series and parallel resonance –frequency response – Quality factor and Bandwidth –Self and mutual inductance — Coefficient of coupling Analysis of coupled circuits– Single Tuned circuits.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On completion of the course, student will be able to

CO1: To acquire knowledge on Ohm's Law and Kirchhoff 's laws.

CO2: Ability to determine behavior of the DC and AC circuit by using mesh analysis/ nodal analysis / network theorems

CO3: Ability to Compute the transient response of first order and second order systems to step and sinusoidal input.

CO4: To acquire knowledge on line/ phase voltage and currents of the three-phase circuit

CO5: To understand the concepts of the frequency response of series and parallel RLC circuits

TEXTBOOKS

1. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis", McGraw Hill publishers, 9thedition, New Delhi, 2020.
2. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2019.
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), Dhanpat Rai & Sons, New Delhi, 2020.
2. Joseph A. Edminister, Mahmood Nahvi, "Electric circuits", Schaum's series, McGraw-Hill,First Edition, 2019.
3. M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 2015.
4. Richard C. Dorf and James A. Svoboda, "Introduction to Electric Circuits", 7th Edition, John Wiley Sons, Inc. 2018.

5. Sudhakar A and Shyam Mohan SP, “Circuits and Networks Analysis and Synthesis”, McGraHill , 2015.

CO - PO and CO - PSO MAPPING

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

1 - low, 2 – medium, 3 – high, ‘-‘ – no correlation

EI3361	ELECTRON DEVICES AND CIRCUITS	L T P C
		3 0 0 3

COURSE OBJECTIVES:

- To understand the structure, operation and applications of electronic devices.
- To familiarize Characteristics & Small signal Model of BJT.
- To explore the Characteristics & Small signal Model of Field Effect Transistor and Operation of Thyristor
- To learn the function of Differential amplifier and power
- To provide adequate knowledge in negative feedback amplifiers and to design RC and LC tuned oscillators for a given frequency.

UNIT - I PN JUNCTION DEVICES 9

PN junction diode — Structure, Operation and V-I characteristics, Diffusion and Transition capacitance - Rectifiers — Half Wave and Full Wave Rectifier — Zener diode - Zener Reverse characteristics — Zener diode as voltage regulator - Display devices- LED, Laser diodes, Photo diode.

UNIT - II BJT AND SMALL SIGNAL AMPLIFIERS 9

BJT - structure, operation of NPN and PNP transistor, Input and output characteristics of CE, CB and CC configurations. Two port Devices and Hybrid Model of BJT for CE, CB and CC configurations - small signal model — Analysis of CE, CB, CC amplifiers.

UNIT - III FIELD EFFECT TRANSISTORS AND THYRISTORS 9

JFET, MOSFET and IGBT - Structure, operation and characteristics - FET small signal model - Analysis of CS, CG and CD amplifier. Thyristor - SCR operation and characteristics, UJT - operation and characteristics.

UNIT - IV DIFFERENTIAL AMPLIFIER AND POWER AMPLIFIERS 9

Differential amplifier – Common mode and Difference mode analysis – FET input stages – Single tuned amplifiers – Gain and frequency response –Power amplifiers – Types:- Class A, B, AB and C Power amplifiers-Push-Pull amplifiers (Qualitative analysis only).

UNIT - V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of Negative feedback — voltage / current, Series, Shunt feedback — Positive feedback – Condition for oscillations, RC Phase shift, Wien bridge, Hartley, Colpitts and Crystal oscillators.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, student will be able to

CO 1: Explain the operation and characteristics of Semiconductor Diodes.

CO 2: Formulate the expression for voltage gain, current gain, input resistance and output resistance of BJT CE,CB and CC amplifier using h-parameter model.

CO 3: Formulate the expression for voltage gain, input resistance and output Resistance of FET amplifier under CS,CG and CD and operation of T hyristor.

CO 4: Explain the operation of differential amplifier, single tuned amplifier and power amplifiers.

CO 5: Analyze the operation of negative feedback amplifiers and to design RC and LC tuned Oscillators for a given frequency range.

TEXT BOOKS:

1. David A. Bell ,"Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits",8th Ed., Oxford University Press 2020.
3. R.S.Sedha,"A textbook of Electronic circuits ", S.Chand and Company Ltd.4/e , 2010.
4. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", McGraw Hill Education (India)Private Limited,4th Edition, 2017.

REFERENCES BOOKS:

1. Balbir Kumar, Shail.B.Jain, “Electronic devices and circuits” PHI learning private limited,2nd edition 2014.
2. Thomas L.Floyd, “Electronic devices” Conventional current version, Pearson prentice hall,10th Edition, 2017.
3. Donald A Neamen, “Electronic Circuit Analysis and Design” Tata McGraw Hill, 3rd Edition,2003.
4. Robert Boylestad and Louis Nashelsky.,“Electron Device and Circuit Theory” Prentice HallPrivate Limited,11th edition, 2017.
5. Jacob Millman, Christos C Halkias, SatyabrataJit, ‘Electronic Devices and circuits’,McGraw Hill education, 4th edition, 2015.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	1	1	-	-	-	1		1	-	-	1	-	-	2
2	3	3	3	3	-	-	-	1		1	-	-	1	-	-	3
3	3	3	3	3	-	-	-	1		1	-	-	1	-	-	1
4	2	2	1	1	-	-	-	1		1	-	-	2	-	-	2
5	3	3	3	2	-	-	-	1		1	-	-	1	-	-	2
Avg.	**2.6**	**2.6**	**2.2**	**2**	**-**	**-**	**-**	**1**		**1**	**-**	**-**	**1.2**	**-**	**-**	**2**

1 - low, 2 – medium, 3 – high, ‘-‘ – no correlation

CS3361 OBJECT ORIENTED PROGRAMMING L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand Object Oriented Programming concepts and basics of Java programming language
- To know the principles of packages, inheritance and interfaces
- To develop a java application with threads and generics classes
- To define exceptions and use I/O streams
- To design and build Graphical User Interface Application using JAVAFX

UNIT – I: INTRODUCTION TO OOP AND JAVA 9

Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming — Java Buzzwords — Overview of Java — Data Types, Variables and Arrays – Operators – Control Statements – Programming Structures in Java – Defining classes in Java – Constructors - Methods -Access specifiers - Static members- Java Doc comments.

UNIT – II: INHERITANCE, PACKAGES AND INTERFACES 9

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword - Method Overriding –Abstract Classes — final with Inheritance. Packages and Interfaces: Packages — Packages and Member Access –Importing Packages — Interfaces.

UNIT – III: EXCEPTION HANDLING AND MULTITHREADING 9

Exception Handling basics — Multiple catch Clauses — Nested try Statements — Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads — Priorities — Synchronization — Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading.

UNIT – IV: I/O, GENERICS, STRING HANDLING 9

I/O Basics — Reading and Writing Console I/O — Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

UNIT – V: JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS 9

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, ToggleButton — RadioButtons — ListView — ComboBox — ChoiceBox – Text Controls – ScrollPane. Layouts – FlowPane – HBox and VBox – BorderPane — StackPane — GridPane. Menus — Basics — Menu — Menu bars — MenuItem.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Apply the concepts of classes and objects to solve simple problems

CO2: Develop programs using inheritance, packages and interfaces

CO3: Make use of exception handling mechanisms and multithreaded model to solve real world problems

CO4: Build Java applications with I/O packages, string classes, Collections and generics concepts

CO5: Integrate the concepts of event handling and JavaFX components and controls for developing GUI based applications

TEXT BOOKS:

1. Herbert Schildt, “Java: The Complete Reference”, 11 th Edition, McGraw Hill Education, New Delhi, 2019
2. Herbert Schildt, “Introducing JavaFX 8 Programming”, 1 st Edition, McGraw Hill Education, New Delhi, 2015.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO's	PO's												PSO's			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	1	1	3	1	3	—	—	—	3	2	2	2	3	1	2	2
2	2	1	3	2	1	—	—	—	2	1	1	3	3	3	2	1
3	3	3	1	2	2	—	—	—	3	2	1	2	3	1	3	2
4	3	1	2	2	2	—	—	—	1	2	1	3	3	1	1	2
5	1	1	2	3	2	—	—	—	3	2	1	2	3	3	3	1
Avg.	**2**	**1.**	**2.2**	**2**	**2**	**–**	**–**	**–**	**2.**	**1.8**	**1.2**	**2.4**	**3**	**1.8**	**2.2**	**1.6**

1 - low, 2 – medium, 3 – high, '-' – no correlation

MD3361 SENSORS AND MEASUREMENTS L T P C

3 0 2 4

OBJECTIVES:

- To study the purpose, methods, errors associated with the measurements.
- To learn the principle of transduction, classifications and the characteristics of different transducers
- To understand the knowledge of the different bridges used for the measurements.
- To identify the concepts of display and recording devices.
- To explore the types of biosensors.

UNIT – I: FUNDAMENTALS OF MEASUREMENTS 9

Measurement System — Instrumentation - Classification and Characteristics of Transducers - Static and Dynamic - Errors in Measurements and their statistical analysis- methods of error analysis,-uncertainty analysis-expression of uncertainty: accuracy and precision index, propagation of errors– Calibration - Primary and secondary standards.

UNIT – II: DISPLACEMENT, PRESSURE, TEMPERATURE SENSORS 9

Strain Gauge: Gauge factor, sensing elements, configuration, and unbounded strain gage. Capacitive transducer - various arrangements, Inductive transducer, LVDT, Passive types: RTD materials & range, relative resistance vs. temperature characteristics, thermistor characteristics, Active type: Thermocouple - characteristics.

UNIT – III: PHOTOELECTRIC AND PIEZO ELECTRIC SENSORS 9

Phototube, scintillation counter, photo multiplier tube (PMT), photovoltaic, photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers. Optical displacement sensors and optical encoders. Piezoelectric active transducer- Equivalent circuit and its characteristics.

UNIT – IV: SIGNAL CONDITIONING CIRCUITS AND METERS 9

Functions of signal conditioning circuits, Preamplifiers, Concepts of passive filters, Impedance matching circuits, AC and DC Bridges - wheat stone bridge, Kelvin, Maxwell, Hay, Schering, Q-meter, PMMC, MI and dynamometer type instruments - DC potentiometer- Digital voltmeter — Multi meter.

UNIT – V: RECORDING DEVICES AND ADVANCED SENSORS 9

CRO — block diagram, CRT — vertical & horizontal deflection system, DSO, LCD monitor, PMMC writing systems, servo recorders, photographic recorder, magnetic tape recorder, Inkjet recorder, thermal recorder. Biosensors: transduction mechanism in a biosensor and Classification - Electronic nose.

PERIODS: 45

LIST OF EXPERIMENTS

1. Characteristics of thermistor and thermocouple
2. Characteristics of LDR , Photo Diode and Photo transistor
3. Characteristics of RTD and LVDT
4. Measurement of unknown Resistance using Kelvin Double Bridge and Wheatstone bridge
5. Measurement of unknown Capacitance using Schering Bridge
6. Measurement of unknown Inductance using Maxwell's & Hay's Bridge
7. Characteristics of strain gauge.
8. Demonstration of CRO
9. Characteristic of A/D and D/A converter

PERIODS: 30

TOTAL PERIODS: 75

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Measure various electrical parameters with accuracy, precision, resolution.

CO2: Understand the basic principles of sensors and transducers.

CO3: Select appropriate light sensors for measurement of physical phenomenon

CO4: Use AC and DC bridges for relevant parameter measurement.

CO5: Employ multimeter, CRO and different types of recorders for appropriate measurement.

LABORATORY REQUIREMENTS FOR A BATCH OF 30 STUDENTS

S.No	Description of Equipment	Quantity Required
1	Strain gauge Trainer Kit	**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	Multi meter	**Each 10**
18	Regulated power supply	**10**
19	ICs – A/D and D/A	**1**
20	CRO	**10**
21	Connecting wires	

TEXT BOOKS:

1. A.K.Sawhney, “Electrical & Electronics Measurement and Instrumentation”, 10th edition, Dhanpat Rai & Co, New Delhi, 19th Revised edition 2011, Reprint 2014.
2. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Ernest O Doebelin, Dhanesh N.Manik “Measurement Systems — Applications and Design”, seventh Edition, McGraw-Hill, 2019

REFERENCE BOOKS:

1. Khandpur R.S, “Handbook of Biomedical Instrumentation”, 3rd edition, Tata McGraw-Hill, New Delhi, 2014.
2. Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015.
3. Albert D.Helfrick and William D. Cooper. Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, 1st edition, 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
CO1	3	2	2	1	1	-	-	2	2	1	1	1	2	-
CO2	3	3	2	1	3	-	-	2	2	-	3	1	3	-
CO3	3	3	2	1	-	2	2	2	2	1	3	-	2	2
CO4	3	3	3	2	-	-	-	2	2	2	3	-	2	-
CO5	3	3	3	1	3	-	-	2	2	3	3	2	2	2
Avg.	**3**	**2.8**	**2**	**1.2**	**1.4**	**2**	**2**	**2**	**2**	**1.4**	**2.6**	**1.3**	**2.2**	**2**

EI3365	ELECTRON DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES:

- To understand the behavior of semiconductor devices and rectifiers experimentally.
- To implement the characteristics of BJT under different configurations.
- To get familiarized on JFET, SCR and UJT.
- To design the amplifiers.
- To develop oscillators.

LIST OF EXPERIMENTS

1. Characteristics of PN Junction diode.
2. Single phase half wave and full wave rectifiers with capacitive filters.
3. Characteristics of Zener diodeand Zener as series voltage regulator.
4. Characteristics of photo diode, Study of light activated relay circuit.
5. Characteristics of Bipolar Junction Transistor under common emitter configuration.
6. Characteristics of BJT under common base configuration.
7. Characteristics of JFET.
8. Study the characteristics of SCR.
9. Study the Characteristics of UJT and generation of saw tooth waveforms.
10. Differential amplifiers using FET.
11. Design and testing of Feedback amplifiers (Any one type)
12. Design and testing of RC phase shift, LC oscillators.
13. Simulation of rectifier circuits using SIMULINK.

TOTAL: 45 PERIODS

COURSE OUTCOMES

On completion of the course, student will be able to

CO 1: Determine the Breakdown voltage, forward and reverse resistance of PN junction diode and Zener diode and Calculate the ripple factor of rectifier circuits with filters.

CO 2: Analyze the characteristics of BJT under CE and CB configuration.

CO 3: Obtain the UJT, SCR and JFET parameters from the characteristics.

CO 4: Calculate the gain of differential amplifier using FET.

CO 5: Design the RC and LC tuned oscillators for a given oscillating frequency and develop feedback amplifiers.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl. No.	Description of Equipment	Required numbers
1	Regulated Power Supply – Dual, 0-30V, variable	10
2	Cathode Ray Oscilloscope, 0-30 MHz	8
3	Digital Multimeter	10
4	Function Generator, 0 – 20 MHz	8
5	Breadboard	10
6	PN Junction diode – 1N4007	20
7	Zener diode – FZ5.6 / FZ9	10
8	Photo diode – S7184	10
9	BJT – BC107 / BC547	10
10	JFET – BFW10 / BFW11	10
11	UJT — 2N2646	10
12	SCR - 2N2324	10
13	Step-down transformer – 230V/12-0-12V	10
14	Capacitors, assorted	10 each
15	Resistors 1/4W, assorted	10 each
16	Single-strand wires, different colours	10 each
17	MATLAB Software	Few Licenses

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	1
2	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	2
3	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	1
4	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	1
5	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	2
Avg.	**3**	**2**	**1**	**-**	**-**	**2**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1.4**

1 - low, 2 – medium, 3 – high, '-' – no correlation

CS3364 OBJECT ORIENTED PROGRAMMING LABORATORY L T P C

0 0 3 1.5

COURSE OBJECTIVES:

- To build software development skills using java programming for real-world applications.
- To understand and apply the concepts of classes, packages, interfaces, inheritance, exception handling and file processing.
- To develop applications using generic programming and event handling

LIST OF EXPERIMENTS:

1. Solve problems by using sequential search, binary search, and quadratic sorting algorithms (selection, insertion)
2. Develop stack and queue data structures using classes and objects.
3. Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no as members. Inherit the classes, Programmer, Assistant Professor, Associate Professor and Professor from employee class. Add Basic Pay (BP) as the member of all the inherited classes with 97% of BP as DA, 10 % of BP as HRA, 12% of BP as PF, 0.1% of BP for staff club funds. Generate pay slips for the employees with their gross and net salary.
4. Write a Java Program to create an abstract class named Shape that contains two integers and an empty method named printArea(). Provide three classes named Rectangle, Triangle and Circle such that each one of the classes extends the class Shape. Each one of the classes contains only the method printArea( ) that prints the area of the given shape.
5. Solve the above problem using an interface.
6. Implement exception handling and creation of user defined exceptions.
7. Write a java program that implements a multi-threaded application that has three threads. First thread generates a random integer every 1 second and if the value is even, the second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of the cube of the number
8. Write a program to perform file operations.
9. Develop applications to demonstrate the features of generics classes.
10. Develop applications using JavaFX controls, layouts and menus.

11. Develop a mini project for any application using Java concepts.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1 : Design and develop java programs using object oriented programming concepts

CO2 : Develop simple applications using object oriented concepts such as package, exceptions

CO3: Implement multithreading, and generics concepts

CO4 : Create GUIs and event driven programming applications for real world problems

CO5: Implement and deploy web applications using Java

Lab Requirements:

For a batch of 30 students

1. Operating Systems: Linux / Windows
2. Front End Tools: Eclipse IDE / Netbeans IDE

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO's	PO's												PSO's			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	1	2	1	—	—	—	—	1	2	2	2	1	2	3	2
2	2	1	3	1	—	—	—	—	2	3	3	2	1	3	1	2
3	2	2	1	2	1	—	—	—	1	2	1	3	2	3	2	1
4	2	2	1	3	—	—	—	—	3	1	1	1	2	1	2	1
5	1	3	3	1	3	—	—	—	1	1	1	1	2	1	2	2
AVg	**2**	**2**	**2**	**2**	**2**	**–**	**–**	**–**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

1 - low, 2 – medium, 3 – high, '-' – no correlation

MA3427	APPLIED MATHEMATICS FOR BIO - MEDICAL ENGINEERING	L T P C 2 0 0 2

OBJECTIVES:

- To understand the basic concepts of probability, one dimensional random variables
- To understand the basic concepts of probability, two dimensional random variables
- To provide basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To introduce the basic notions of vector spaces this will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations.

UNIT-I: PROBABILITY AND RANDOM VARIABLES 6L

Axioms of probability – Conditional Probability-Discrete and continuous random variables-– Moments – Moment generating functions

UNIT-II: TWO - DIMENSIONAL RANDOM VARIABLES 6L

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression

UNIT-III: RANDOM PROCESSES 6L

Classification – Stationary process – Markov chain- Poisson process

UNIT-IV: VECTOR SPACES 6L

Vector spaces – Subspaces – Linear combinations– Linear independence and linear dependence – Bases and dimensions (definition only)

UNIT-V: LINEAR TRANSFORMATION 6L

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of linear transformations

TOTAL: 30L PERIODS

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Understand the basic concepts of one and two dimensional random variables and apply them to model engineering problems.

CO2: Understand the fundamental concepts of probability with a thorough knowledge of standard distributions that can describe certain real-life phenomenon.

CO3: Apply the concept of random processes in engineering disciplines.

CO4: Demonstrate accurate and efficient use of advanced algebraic techniques.

CO5: Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.

TEXT BOOKS:

1. Ibe, O.C., “Fundamentals of Applied Probability and Random Processes", Elsevier,1st Indian Reprint, 2007.
2. Friedberg. A.H., Insel. A.J. and Spence. L., “Linear Algebra”, Prentice Hall of India, New Delhi, 4th Edition, 2004.
3. Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., “Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014

REFERENCE BOOKS:

1. Hsu, "Schaum’s Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, New Delhi, 2004.
2. Yates, R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.
3. Kolman. B. Hill. D.R., “Introductory Linear Algebra”, Pearson Education, New Delhi, First Reprint, 2009.
4. Kumaresan. S., “Linear Algebra – A Geometric Approach”, Prentice – Hall of India, New Delhi, Reprint, 2010.
5. Strang. G., “Linear Algebra and its applications”, Thomson (Brooks/Cole), New Delhi,2005..

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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

No Correlation - Low 1 Medium 2 High 3

MD3461 HUMAN ANATOMY AND PHYSIOLOGY L T P C

3 0 0 3

OBJECTIVES:

- To learn the elements and planes in the human body.
- To identify all the organelles of an animal cell and their function.
- To analyze the cells, tissues, organs and organ systems in body.
- To explore the structure and functions of the types of systems of the human body.
- To acquire knowledge about anatomical features and physiology of human systems.

UNIT – I: INTRODUCTION 9

Level of Organization – Metabolism and Homeostasis – Plan of Body – Body Parts and Areas, Planes and Sections. Elements in the Human Body — Inorganic Compounds and Organic Compounds

UNIT – II: CELL AND TISSUE STRUCTURE, SENSE ORGANS 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. Sense Organs: Eye, Ear.

UNIT – III: 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 – IV: 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 – 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:

On completion of the course, student will be able to

CO1: Assess the overall levels of organization and importance of homeostasis in the human body.

CO2: Explain the organelles in cell, tissues, organs and organ system in human body.

CO3: Analyze the structure and physiological function of Skeletal, Muscular and Respiratory system.

CO4: Describe the structure and function of Cardiovascular and Lymphatic system.

CO5: Explore the structure and function of the 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.
3. Valerie C. Scanlon and Tina Sanders, “Essential of Human Anatomy and Physiology”, Fifth Edition, F.A. Davis Company, Philadelphia 2007

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
CO1	3	-	-	-	-	-	-	3	-	-	-	-	2	2
CO2	3	-	-	2	-	-	-	2	-	-	-	2	2	2
CO3	3	-	-	2	-	-	-	2	-	-	-	2	2	2
CO4	3	-	-	2	-	-	-	2	-	-	-	2	2	2
CO5	3	-	-	-	-	-	-	2	-	-	-	2	2	2
Avg.	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**2.2**	**-**	**-**	**-**	**2**	**2**	**2**

1 - low, 2 – medium, 3 – high, ‘-‘ – no correlation

MD3462	BIO CONTROL SYSTEMS	L T P C
		3 0 0 3

OBJECTIVES:

- To Understand the concept behind feedback and continuum in various systems and subsystems and the need for mathematical modeling of various systems.
- To analyze the systems in time domains.
- To Gain knowledge about the systems in frequency domain.
- To Interpret the concept of stability of various systems.
- To apply mathematical modeling principles in understanding the various fundamental biological systems.

UNIT - I: INTRODUCTION 9

Open and Closed loop Systems, Mathematical Modeling of systems, Block diagram and signal flow graph representation of systems - reduction of block diagram and signal flow graph, Introduction to Physiological control systems- Illustration, Linear models of physiological systems, Difference between engineering and physiological control systems.

UNIT - II: TIME RESPONSE ANALYSIS 9

Step and impulse responses of first order and second order systems - time domain specifications of first and second order systems - steady state error constants.

UNIT - III: FREQUENCY RESPONSE ANALYSIS 9

Frequency domain specifications - Polar plots - Bode plots - Nyquist plot - Nyquist stability criterion, closed loop stability - Constant M and N circles - Nichol‘s chart.

UNIT - IV: STABILITY ANALYSIS 9

Definition of stability, Routh- Hurwitz criteria of stability, Root locus technique - construction of root locus and study of stability.

UNIT - V: BIOLOGICAL CONTROL SYSTEM ANALYSIS 9

Simple models of muscle stretch reflex action - steady state analysis of muscle

stretch reflex action, transient response analysis of neuromuscular reflex model action, frequency response of circulatory control model, Stability analysis of Pupillary light reflex.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Interpret the need for mathematical modeling, representation of systems and introduction to biological control systems.

CO2: Determine the time response of various systems.

CO3: Examine the frequency response characteristics of systems using charts.

CO4: Discuss the concept of system stability.

CO5: Appraise the concept of modeling basic physiological systems.

TEXT BOOKS:

1. I.J. Nagarath and M. Gopal, Control Systems Engineering, New Age International Publishers, 1st September 2018.
2. Michael C. Khoo, Physiological Control Systems, Analysis, Simulation and Estimation, IEEE Press, 2018.

REFERENCE BOOKS:

1. Salivahanan S. Rengaraj R. and Venkatakrishnan G. R., Control Systems Engineering, Pearson Education India, 2015.
2. Benjamin C. Kuo, Automatic Control Systems, Prentice Hall of India, 1995.
3. Ogata, Katsuhiko and Yanjuan Yang, Modern control engineering, Vol 4, Prentice-Hall, 2002.

ONLINE RESOURCES:

1. https://nptel.ac.in/courses/108/101/108101037/
2. https://nptel.ac.in/content/storage2/courses/112104158/lecture14.pdf
3. https://nptel.ac.in/content/storage2/courses/112104158/lecture16.pdf
4. https://nptel.ac.in/content/storage2/courses/112104158/lecture17.pdf

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
CO1	3	2	2	2	-	2	1	-	-	1	-	-	2	1
CO2	3	2	2	2	1	-	-	-	-	-	-	2	2	1
CO3	3	2	2	2	-	-	-	-	-	1	-	-	2	1
CO4	3	2	2	2	1	-	1	-	-	-	1	-	2	1
CO5	3	2	2	2	2	-	-	2	1	-	-	2	2	1
Avg.	**3**	**2**	**2**	**2**	**1.3**	**2**	**1**		**1**	**1**	**1**	**2**	**2**	**1**

1 - low, 2 – medium, 3 – high, '-' – no correlation

MD3463 ANALOG AND DIGITAL INTEGRATED CIRCUITS **L T P C**
3 0 0 3

OBJECTIVES:

- To study the circuit configuration and introduce practical applications of linear integrated circuits.
- To understand the concept of application of ADC and DAC in real time systems and Phase Locked Loop with applications.
- To learn the design of digital fundamentals using logic gates.
- To design combinational digital circuits using logic gates.
- To familiarize the design procedures for synchronous and asynchronous sequential circuits.

UNIT I INTRODUCTION TO OPERATIONAL AMPLIFIER AND ITS APPLICATIONS **9**

Operational amplifier –ideal characteristics, Performance Parameters, Linear and Nonlinear Circuits and their analysis- voltage follower, Inverting amplifier, Non-inverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters, Comparator, Multivibrator and Schmitt trigger.

UNIT II DIGITAL TO ANALOG AND ANALOG TO DIGITAL CONVERTERS AND PLL **9**

Types of D/A converter -Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, Voltage to Frequency converters. PLL-Closed loop analysis of PLL, Frequency multiplication/ division, FSK demodulator.

UNIT III THE BASIC GATES AND COMBINATIONAL LOGIC CIRCUITS **9**

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes –Binary, BCD, 84-2-1, 2421, Excess 3,Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms,

Karnaugh map and tabulation methods. Logic families- TTL, MOS, CMOS, BiCMOS — Comparison of Logic families.

UNIT IV COMBINATIONAL LOGIC CIRCUITS 9

Design of combinational circuits - Code-Converters, Half and Full Adders, Binary Parallel Adder — Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux/Demux.

UNIT V SEQUENTIAL LOGIC CIRCUITS 9

Flip flops – SR, JK, T, D, Master/Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits — state minimization, state assignment, circuit implementation. Counters, Ripple Counters, Ring Counters. Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In -Serial Out, Parallel In - Parallel Out, Universal Shift Register.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Design new analog linear circuits and develop linear IC based systems.

CO2: Apply the concept of ADC and DAC in real time systems and Phase Locked Loop with applications.

CO3: Use Boolean algebra and apply it to digital systems.

CO4: Design combinational digital circuits using logic gates.

CO5: Explore the analysis and design procedures for synchronous and asynchronous sequential circuits.

TEXT BOOK

1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd.,New Delhi, 2018.
2. John.F.Wakerly, “Digital design principles and practices”, Pearson Education, 5th Edition, 2018.

3. David J Comer, "Digital Logic and State Machine Design", Oxford University Press, NewDelhi, 2017.

REFERENCES

1. Ramakant A, Gayakwad, “OP-AMP and Linear ICs”, Prentice Hall of India, New Delhi,2017.
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", McGraw Hill India, New Delhi, 2017.
3. Thomas L.Floyd , "Digital Fundamentals", Pearson Education, England, 2021.

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
CO1	3	2	3	2	1	1	-	-	-	-	2	2	3	1
CO2	3	2	2	2	1	1	-	-	-	-	2	2	1	1
CO3	3	3	3	1	1	1	-	-	-	-	2	2	1	1
CO4	3	3	3	1	1	1	-	-	-	-	3	3	1	1
CO5	3	3	3	1	1	1	-	-	-	-	2	2	1	1
Avg.	**3**	**3**	**3**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**2.2**	**2.2**	**1.4**	**1**

1 - low, 2 – medium, 3 – high, ‘-‘ – no correlation

EC3464 MICROPROCESSORS, MICROCONTROLLERS AND INTERFACING **L T P C 3 0 0 3**

OBJECTIVES:

- To understand the Architecture of 8086 microprocessor.
- To study about multiprocessor configurations and bus structure.
- 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 PIC microcontroller based system for application specific solution.

UNIT-I: THE 8086 MICROPROCESSOR **9**

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives — Assembly language programming — Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines.

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: PERIPHERALS AND INTERFACING **9**

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface –- Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications.

UNIT-IV: 8051 MICROCONTROLLER & INTERFACING **9**

Architecture of 8051 — Special Function Registers (SFRs) - Instruction set - Addressing modes — Times - Serial Port — Interrupts - Assembly language programming. LCD & Keyboard Interfacing - Sensor Interfacing - External Memory Interfacing- Stepper Motor Interfacing.

UNIT-V: PIC MICROCONTROLLER & INTERFACING 9

PIC Microcontroller - Features and Architecture, Classification of Instructions, PIC18 Programming in C, Timer, Serial Port and Interrupt, PIC18 Interfacing: ADC, DAC, and Sensor.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Acquire the knowledge on architectural concepts of 8086 microprocessor

CO2: Understand bus interfacing systems and analyze the Coupled communication systems.

CO3: Explore and design the interface of I/O circuits.

CO4: Design the interfacing applications with microprocessor.

CO5: Formulate and implement 8051 microcontroller based systems.

CO6: Develop new systems based on PIC microcontroller.

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. (UNIT I- III)
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, ―The 8051 Microcontroller and Embedded Systems: Using Assembly and C‖, Second Edition, Pearson education, 2011. (UNIT IV)
3. Muhammad Ali Mazidi, Rolind D. Mckinlay and Danny Causey. “PIC Microcontroller and Embedded Systems”, Pearson Education, 2008. (UNIT V)

REFERENCES:

1. Doughlas V.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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	1	2	1	3	1	-	2	-	-	-	2	2	1	3	-
2	2	2	2	1	-	-	-	2	-	-	-	2	2	1	3	-
3	2	1	2	1	3	1	-	2	-	-	-	2	2	1	3	-
4	2	1	2	1	3	1	-	2	-	-	-	2	2	1	3	1
5	2	1	2	3	3	1	-	2	-	-	2	2	2	1	3	2
6	2	1	2	3	3	1	-	2	-	-	3	2	2	1	3	3
Avg	**2**	**1.2**	**2**	**1.7**	**3**	**1**	**-**	**2**	**-**	**-**	**2.5**	**2**	**2**	**1**	**3**	**2**

1 - low, 2 – medium, 3 – high, ‘-‘ – no correlation

GE3451	NCC Credit Course Level - I	L T P C
	(Common to Army, Navy & Air)	3* 0 0 3*

Objective:

- To know the basic structure of NCC and Role of NCC
- To improve the cadet's personality skill and leadership quality
- To make the interest of cadets to involve in social activities
- Preventing the potential damage and suffering
- To destruction of the enemy's ability to fight and will to fight

Unit I Introduction to NCC 6

Aims, Objectives & Organization of NCC, Incentives, Duties of NCC Cadet, NCC Camps and Types National Integration: Importance & Necessity, Factors Affecting National Integration, Unity in Diversity & Role of NCC in Nation Building, Threats to National Security.

Unit II Personality Development 6

Personal Transformation, Personal Productivity Skills - time management, organizational and planning skills, problem solving and decision-making abilities, basics of psychology, Leadership, Meditation

Unit III Social Service and Community Development 6

Basics, Rural Development Programmes, NGOs, Contribution of Youth, Protection of Children and Women Safety, Road / Rail Travel Safety, New Initiatives, Cyber and Mobile Security Awareness

Unit IV Disaster Managements and its Awareness 6

Importance of Hazards and Disaster, Types of disasters, Earthquakes and its types, flood types and its management, landside and its managements case studies of disasters in Sikkim, Training and drills for disaster preparedness, Awareness generation program, Usages of GIS and Remote sensing techniques in disaster management.

Unit V War and Peace in Contemporary World 6

Conceptual framework of War and Peace, Concepts of theories and approaches, Modern /war fare: Conventional, nuclear, Guerilla and Irregular Warfare, Limited and Specialized Warfare with reference to mountain, desert and jungle warfare, terrorism as a new mode of conflict, War as an Economic Problem, Defence and Development, Defence and Development, Defence and Development

TOTAL: 30 PERIODS

Note: NCC Credit Course Level — I is offered for NCC students only. The grades earned by the students will be recorded in the marksheet, however the same shall not be considered for the computation of CGPA.

Course outcome:

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

CO1: Understand their roles and responsibilities

CO2: Demonstrate the knowledge of human values and morals

CO3: Actively participate in social service and development activities

CO4: Understand the importance of disaster management

CO5: Analyse the issues related to war and its effects.

Text Books

1. R. Gupta's NCC Handbook of NCC Cadets 'A', 'B' and 'C' certificate Examinations

Reference book:

1. V. B. RAO, Personality Development and Soft Skills, BS Publications
2. Harish K. Gupta, Disaster Management, Universities press

MD3464 MEDICAL INSTRUMENTATION L T P C

3 0 2 4

OBJECTIVES:

- To understand the basic concepts of medical instrumentation and bio sensors.
- To identify the physiological characteristics of Bio signals.
- To know about amplifiers and applications.
- To explore the basic measurements of physiological parameters.
- To acquire knowledge about the biochemical measurement techniques as applicable for diagnosis and treatment.

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 : 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 BIOSIGNAL CHARACTERISTICS 9

Bio signals characteristics — ECG-frequency and amplitude ranges — Einthoven's triangle, standard 12 lead system. EEG - EEG — 10-20 electrode system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration -unipolar and bipolar mode.

UNIT III BIOAMPLIFIERS 9

Need for bio-amplifier - Differential bio-amplifier — Single ended amplifier - Band pass filtering, isolation amplifiers — transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Power line interference.

UNIT – IV: 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 V BIOCHEMICAL MEASUREMENTS 9

Biochemical sensors - pH, pO2 and pCO2, Ion selective Field effect Transistor (ISFET), Immunologically sensitive FET (IMFET), Blood glucose sensors. Blood gas analyzers, colorimeter, flame photometer, spectrophotometer, blood cell counter, auto analyzer.

PERIODS: 45

PRACTICALS:

1. Simple Op Amp Circuit Measurements.
2. Design and analysis of biological pre-amplifiers.
3. Blood pressure measurement.
4. Experiment of Photo-plethysmography.
5. Recording of ECG signal and analysis.
6. Recording of EMG-Signal.
7. Recording of various physiological parameters using patient monitoring system and telemetry units.
8. Measurement of respiration rate
9. Measurement of PH and Conductivity

PERIODS: 30

TOTAL PERIODS: 75

COURSE OUTCOMES:

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

CO1: Illustrate the origin of various biological signals medical terms and their Characteristics physical values,

CO2: Gain knowledge on characteristics of bio signals.

CO3: Explore amplifiers involved in monitoring and transmission of

biosignals.

CO4: Analyze the measurement techniques for non-electrical bio-parameters

CO5: Examine the biochemical measurement techniques as applicable for Diagnosis and further treatment.

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	Photo-plethysmograph unit	1 No.
3	Multiparameter patient monitoring system	1 No.
4	Respiration measurement kit	1 No.
5	ECG recorder	1 No.
6	EMG recorder	1 No.
7	Blood flow measurement system using ultrasound transducer	1 No.
8	Function Generators	10 Nos
9	P^H and conductivity Meter	1 No.
10	DSOs	1 No.
11	Regulated Power supplies	10 Nos
12	Bread boards	1 No.
13	IC 741	30 Nos

TEXT BOOKS:

1. Paul H. King, Richard C. Fries, Arthur T. Johnson, “Design of Biomedical Devices and Systems”, Third Edition, CRC Press, 2014.
2. Leslie Cromwell, “Biomedical Instrumentation and measurement”, 2nd edition, Prentice hall of India, New Delhi, 2015.

3. 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
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	-
Avg.	**2**	**2.7**	**2.7**	**2.5**	**3**	**2.5**	**2.5**	**2**	**2**	**2**	**-**	**2**	**2**	**3**

1 - low, 2 – medium, 3 – high, ‘-‘ – no correlation

MD3465	ANALOG AND DIGITAL INTEGRATED CIRCUITS LABORATORY	L T P C 0 0 3 1.5

OBJECTIVES:

- To study the characteristics of inverting, non-inverting, and instrumentation amplifier.
- To learn the linear and non-linear applications of operational amplifiers.
- To identify the combinational circuits and design procedures.
- To understand the function of sequential circuits.
- To exhibit the student in simulating analog circuits.

LIST OF EXPERIMENTS:

1. Design of inverting and non-inverting amplifier.
2. Design of Integrator and Differentiator.
3. Design of Instrumentation amplifier.
4. Design of Active low pass, High pass filter and Band pass filter
5. Design of Astable and Monostable multivibrator using 555 timer.
6. Design of RC Phase shift and Wien bridge oscillators using op-amp.
7. Design of Schmitt Trigger using op-amp.
8. Study of logic gates, Half adder and Full adder.
9. Design and implementation of multiplexer and demultiplexer.
10. Design and implementation of encoder and decoder using logic gates.
11. Design and implementation of shift registers.
12. Design and implementation of mod-N counter.
13. Simulation and analysis of circuits using software (any open access).

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Learn and design amplifiers using op-amp.

CO2: Explore the filters and multivibrators.

CO3: Analyze the performance of combinational circuits.

CO4: Design and test the performance of sequential circuits.

CO5: Simulate and analyse amplifier circuits using software.

LIST OF LAB EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1. Digital Trainer Kit - 15 Nos. (with 5 V, Variable and fixed frequency Clock, Bread Board, Four Seven Segment displays, LEDs for output display, Logic 1 and 0 Input switches).
2. Logic ICs – 50 Nos each (7400, 7402, 7404, 7408, 7410, 7420, 7432, 7447, 7448, 7474, 7476,7483, , 7485, 7486, 7490, 7495, 74151, 741.
3. NE555 – 50 Nos.
4. Components and Accessories: Resistors, Capacitors, Inductors, diodes, Zener Diodes,Bread Boards, Transformers.IC Power supply (5 V fixed) - 15 Nos.
5. Standalone desktop PCs with SPICE software – 15 Nos.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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
CO1	3	2	1	1	1	-	-	-	-	1	3	3	3	1
CO2	3	2	1	1	1	-	-	-	-	1	2	3	2	1
CO3	3	2	1	1	1	-	-	-	-	1	1	3	2	1
CO4	3	2	1	1	1	-	-	-	-	1	1	3	1	1
CO5	3	2	1	1	3	-	-	-	-	1	3	3	1	2
Avg.	**3**	**2**	**1**	**1**	**1.4**	**-**	**-**	**-**	**-**	**1**	**2**	**3**	**1.8**	**1.2**

1 - low, 2 – medium, 3 – high, '-' – no correlation

EC3467	MICROPROCESSORS, MICROCONTROLLERS AND INTERFACING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To develop assembly Language program for 8086 Microprocessor.
- To introduce string manipulation instructions for 8086 Microprocessor.
- To understand the working of peripheral devices.
- To enumerate programs to interface memory, I/O's with processor.
- To develop assembly Language program for 8051 Microcontroller.
- To explore the Interfacing of stepper motor and temperature sensor with microcontroller

.

LIST OF EXPERIMENTS: 8086 Programs using kits and MASM

1. Basic arithmetic and logical operations.
2. Move a data block without overlap.
3. Code conversion, decimal arithmetic and matrix operations.
4. String manipulations, sorting and searching.

LIST OF EXPERIMENTS: Peripherals and Interfacing Experiments using 8086.

5. Interfacing traffic light controller.
6. Interfacing ADC and DAC.
7. Implementing waveform generation.
8. Interfacing key board and LCD.
9. Analyze serial interface and parallel interface.

LIST OF EXPERIMENTS: 8051 Microcontroller based Experiments using kit and MASM.

10. Program basic arithmetic and logical operations.
11. Interfacing stepper motor and temperature sensor.

LIST OF EXPERIMENTS: PIC18 Microcontroller based Experiments using Proteus Software.

12. Blinking of LED with delay routine
13. Interfacing key board and LCD.
14. Interfacing Temperature sensor

TOTAL PERIODS: 60

OUTCOMES:

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

CO1: Write ALP Programs for Arithmetic operations and Logical operations.

CO2: Express the programming logics for code conversion

CO3: Analyze the working principle of ADC and DAC.

CO4: Interface different I/O's with processor and Generate waveforms using 8086

CO5: Execute microcontroller programs in 8051.

CO6: Design a mini Project using PIC Microcontroller.

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

S.NO	NAME OF THE EQUIPMENT	REQUIRED
1.	Intel Desktop Systems with MASM	10 No's
3.	8086 Microprocessor Trainer with Power Supply	10 No's
4.	8051 Micro Controller Trainer Kit with power supply	5 No's
5.	8255 Interface boards	3 No's
6.	8251 Interface boards	3 No's
7.	8259 Interface boards	3 No's

8.	8279 Keyboard / Display Interface boards	3 No's
9.	8254 timer/ counters, 8253 Timer	3 No's
10.	ADC and DAC cards	3 No's
11.	AC & DC motor with Controllers	2 No's
12.	Traffic Light Control Systems	3 No's
13.	Stepper Motor	3 No's
14.	CRO (Cathode Ray Oscilloscope - 20 MHz)	2 No's

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	3	-	2	-	3	-	-	-	2	2	-	3	2	2	3	-
2	2	-	3	-	3	-	-	-	2	2	-	2	2	-	3	-
3	2	-	3	-	3	-	-	-	2	2	-	2	2	-	3	-
4	1	2	3	-	3	-	-	-	1	2	-	2	2	-	3	-
5	1	2	3	-	3	-	-	-	2	2	-	2	2	-	3	3
6	1	2	3	2	3	2	2	2	2	2	-	2	2	2	3	3
Avg	**1.7**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**1.8**	**2**	**-**	**2.2**	**2**	**2**	**3**	**3**

MD3561 **THERAPEUTIC EQUIPMENT** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made to:

- To gain knowledge on basic concepts of cardiac assist devices.
- To understand the diathermy and medical stimulators.
- To acquire knowledge about the various extra corporeal devices.
- To investigate different respiratory assistance devices.
- 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 Hemodialysis, Dialysate, different types of Hemodialyzers, peritoneal dialyzer 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 ionizing 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

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Explain the basic principles of cardiac assist devices.

CO2: Analyze the function of diathermy and medical stimulators.

CO3: Interpret the operation of extra corporeal devices.

CO4: Examine the functions of different respiratory assistance devices.

CO5: 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
CO1	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO2	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO3	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO4	3	2	1	1	-	-	-	-	-	-	-	-	1	-
CO5	3	2	1	1	-	-	-	-	-	-	-	-	1	-
Avg.	**3**	**2**	**1**	**1**	-	-	-	-	-	-	-	-	**1**	-

MD3562	DISCRETE TIME SIGNAL PROCESSING	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made to:

- To represent the signal in frequency domain using FFT.
- To gain knowledge on the design of IIR filters.
- To understand the design of FIR filters.
- To understand the effects of finite word length on filters.
- To impart knowledge on Digital Signal Processors and Multirate Signal Processing

UNIT – I: DISCRETE FOURIER TRANSFORM 9

Review of signals and systems, concept of frequency in discrete-time signals - Frequency Domain Sampling DFT and its properties, magnitude and phase representation - Linear Convolution – Correlation - Circular Convolution, Overlap-add and overlap-save methods. FFT- Decimation in Time Algorithm, Decimation in Frequency Algorithm. Use of FFT in Linear Filtering.

UNIT – II: INFINITE IMPULSE RESPONSE FILTERS 9

Characteristics of practical frequency selective filters. Characteristics of commonly used Analog filters - Butterworth 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 AND MULTIRATE SIGNAL PROCESSING **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. Multi-rate Signal Processing - Decimation and Interpolation.

UNIT – V: DSP PROCESSORS **9**

Introduction to DSP Processors – Fixed & Floating point processor, Architecture of DSP processor, Addressing Modes, Instruction Set.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

CO1: Apply DFT for the analysis of Digital Signals.

CO2: Understand the concept and Design of IIR filters.

CO3: Examine FIR filter design.

CO4: Interpret the effects of finite precision representation on digital filters.

CO5: Apply Programming concepts on DSP processors and to design multirate filters.

TEXT BOOKS:

1. John G. Proakis & Dimitris G.Manolakis, Digital Signal Processing - Principles, Algorithms & Applications, Fourth Edition, Pearson Education / Prentice Hall, 2016.
2. B. Venkatramani, M Bhaskar, “Digital Signal Processors, Architecture, programming and applications” Mc-Graw Hill.

REFERENCE BOOKS:

1. V. Oppenheim, R.W. Schafer and J.R. Buck, Discrete-Time Signal Processing, 8th Indian Reprint, Pearson, 2014.
2. Sanjit K. Mitra, Digital Signal Processing - A Computer Based Approach, Tata Mc Graw Hill, 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
CO1	3	2	2	2	-	-	-	-	-	1	-	-	3	-
CO2	3	2	2	2	-	-	-	-	1	1	-	-	3	-
CO3	3	2	2	2	-	-	-	-	1	1	1	-	3	-
CO4	3	2	2	2	1	-	-	-	1	1	1	-	3	-
CO5	3	2	2	2	1	-	-	-	1	1	1	-	3	-
Avg.	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**3**	**2**

MD3563	ANALOG AND DIGITAL COMMUNICATION	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made to:

- Learn Analog communication techniques.
- Understand Pulse Modulation techniques.
- Explore Digital Communication techniques.
- Understand the characteristics of noise
- Gain knowledge on Source and Error Control Coding.

UNIT – I: ANALOG COMMUNICATION 9

Introduction to Communication Systems – Electromagnetic Spectrum - Modulation – Types – Need for Modulation. Amplitude Modulation – DSBSC, DSBFC, SSB, VSB – Theory of Frequency and Phase Modulation – Comparison of Analog Communication Systems (AM – FM – PM).

UNIT – II: PULSE MODULATION 9

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

UNIT – III: DIGITAL COMMUNICATION 9

Memory less Modulation methods – Representation and spectral characteristics - Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK) –Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (8QAM & 16 QAM) – Bandwidth Efficiency – Error Performance – Coherent and Non – Coherent Detection Systems

UNIT – IV: NOISE CHARACTERIZATION 9

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

UNIT – V: 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 – ARQ Techniques.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

CO1: Apply Analog communication techniques.

CO2: Recognize Pulse modulation methods.

CO3: Discover Digital communication techniques.

CO4: Understand noise performance Analysis.

CO5: Evaluate Source and Error Control Coding.

TEXT BOOKS:

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.

REFERENCE BOOKS:

1. Simon Haykin, "Communication Systems", 4th Edition, John Wiley & Sons, 2004.
2. John G. Proakis & Masoud Salehi, Communication Systems Engineering, Second Edition, Pearson Education / Prentice Hall, 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
CO1	3	2	3	3	-	2	2	2	-	-	-	2	1	-
CO2	3	3	3	3	-	2	2	2	-	-	-	3	1	-
CO3	3	2	3	3	-	2	-	-	-	-	-	3	1	-
CO4	3	2	3	3	-	3	-	-	-	-	-	2	1	-
CO5	2	3	3	2	-	3	-	2	-	-	-	3	1	-
Avg	2.8	2.4	3	2.8	-	2.4	2	2	-	-	-	2.6	1	-

CE3531	ENVIRONMENTAL STUDIES	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT- I ENVIRONMENT AND BIODIVERSITY 6

Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow– ecological succession. Types of biodiversity: genetic, species and ecosystem diversity– values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity –endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ and Wild Life Act.

UNIT- II ENVIRONMENTAL POLLUTION 6

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts, Environmental policies and various Environmental Programmes conducted around the world.

UNIT- III RENEWABLE SOURCES OF ENERGY 6

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT- IV SUSTAINABILITY AND MANAGEMENT 6

Definition of Sustainability, Aspects of Sustainability, Transition from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs). The Role of UN and the Need for SDGs and Adoption by the World, Scope and Inclusion and Agenda 2030, Our Common Future and Philosophy behind SDGs Design for sustainability, Thinking Alternatives and Innovation, Causal Mapping, Systemic Mapping and Problem Identification Identifying probable interventions for Sustainable Development, Framework and Structuring of Seventeen SDGs.

UNIT- V SUSTAINABILITY PRACTICES 6

Zero waste and 3R concept, ISO 14000 Series, Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy Cycles-carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio-economical and technological change.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
2. To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
3. To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.

4. To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
5. To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXTBOOKS:

1. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers ,2018.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
3. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
4. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
5. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.

REFERENCE BOOKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38 . Edition 2010.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT. LTD, New Delhi, 2007.
4. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, Third Edition, 2015.
5. Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

CE3531	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	-	-	-	2	3					2				
CO2	3	2	-	-	-	3	3					2				
CO3	3	-	1	-	-	2	2					2				
CO4	3	2	1	1	-	2	2					2				
CO5	3	2	1	-	-	2	2					1				
Average	**2.8**	**1.8**	**1.0**	**1.0**	**0.0**	**2.2**	**2.4**	**0.0**	**0.0**	**0.0**	**0.0**	**1.8**	**0.0**	**0.0**	**0.0**	**0.0**

GE3551	NCC Credit Course Level - II (Common to Army, Navy & Air)	L T P C 3 0 0 3

Objective:

- To know the basic principles of adventure program and creating awareness for social
- To improve the cadet's knowledge in firefighting and their health's
- To make the interest to handle the weapons and read the map
- To know the handling the situation on ground in army battle
- To know the about anchors, ropes and communication procedure in the Naval wing

Unit I Adventure and Social awareness program 9

Parasailing, Slithering, Rock Climbing, Cycling and Trekking, Obstacle training. Basic Social Service and its needs, Rural Development Programmes. NGOs: Role and Contribution, Responsibility of Swachh Bharat Abhiyanm, Contribution of Youth towards Social Welfare, Social Security Schemes, Social Evils viz Dowry/ Female Foeticide/ Child abuse and trafficking etc. Protection of Children.

Unit II Fire Fighting and Health and Hygiene 9

Types of fire, Triangle of fire- Types of fire-fighting, water markings in the ship, NBCD organization and structure, Damage control, Aims of First Aid, Principle of First Aid, Motto of First Aid, List of items in First aid Box, Types of Bandages, Types of Fracture, Dislocation, Types of Wounds, Burns and Scalds, Sprain, Strain, Asphyxia, Drowning, Poison, Shock, Snake bite, Sun and Heat Stroke, Insect bite, Dog bite, Hanging, Artificial Respiration, carriage of sick and wounded.

Unit III Weapon Training and Map Reading 9

Characteristics of a rifle/rifle ammunition and its fire power, Stripping, assembling, care and cleaning and sight setting of .22 rifle, Loading, cocking and unloading, The lying posn, holding and Aiming – 1, Range procedure and safety precautions, Theory of group and snap shooting, Introduction of types of Maps and conventional signs, Scales and Grid system, Topographical forms and technical terms, Relief, contours and Gradients, Cardinal points and types of north, Types of Bearings and use of service protracto, Prismatic compass and its use and GPS, Setting a map, finding north and own position,

Map to Ground, Ground to Map, Point to Point March

Unit IV Field Craft and Battle Craft 9

Introduction, Judging Distance, Description of ground, Recognition, description and indication of landmarks and targets, Observation, Camouflage and Concealment, Field Signals, Section Formations, Fire Control Orders, Fire and Movement, Types of knots and lashings.

Unit V Seamanship and Naval Communications 9

Anchor - parts of Anchor , parts of cable Types of Anchor, Rigging- Rope, Types of ropes, Care and maintenance of rope, Bends and Hitches, Shackles and Blocks**,** Introduction to naval modern communication, purpose and principles, duties of various communications department, Semaphore, letters and prosigns, reading and transmission of messages, phonetic alphabets, radio telephony procedure Sonar and Radar.

TOTAL: 45 PERIODS

Note: NCC Credit Course Level – II is offered for NCC students only. The grades earned by the students will be recorded in the marksheet, however the same shall not be considered for the computation of CGPA.

Course outcome:

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

1. Understand the responsibilities of the social works and adventure
2. Learnt about the techniques of firefighting and importance of hygiene
3. Capable to handle the weapons (Rifle .22) and read the map
4. Understand the importance of field and battle craft
5. Devolve the skills about seamanship and naval communication techniques.

Text Books

1. E- Book , NCC Red Book, Director General NCC, Ministry of Defence, RK Puram New Delhi (link: **red book 26-5-2017.pmd (s3waas.gov.in))**
2. Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations, by RPH Editorial Board, Kindle Edition.

EC3564	Embedded Systems and IoT Design	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To learn the architecture and features of 8051.
- To understand the design process of an embedded system.
- To know the real time processing in an embedded system
- To explore the architecture and design flow of IoT.
- To implement the embedded systems and IoT for various applications.
- To design an IoT based system.

UNIT-I: 8051 MICROCONTROLLERS 9

Microcontrollers for an Embedded System – 8051 – Architecture – Addressing Modes – Instruction Set – Program and Data Memory – Stacks – Interrupts – Timers/Counters – Serial Ports – Programming.

UNIT-II: EMBEDDED SYSTEMS 9

Embedded System Design Process – Model Train Controller – ARM Processor – Instruction Set Preliminaries – CPU – Programming Input and Output – Supervisor Mode – Exceptions and Trap – Models for programs – Assembly, Linking and Loading – Compilation Techniques – Program Level Performance Analysis.

UNIT-III: PROCESSES AND OPERATING SYSTEMS 9

Structure of a real – time system – Task Assignment and Scheduling – Multiple Tasks and Multiple Processes – Multirate Systems – Pre emptive real – time Operating systems – Priority based scheduling – Interprocess Communication Mechanisms – Distributed Embedded Systems – MPSoCs and Shared Memory Multiprocessors – Design Example – Audio Player, Engine Control Unit and Video Accelerator.

UNIT-IV: IOT ARCHITECTURE AND PROTOCOLS 9

Internet of Things – Physical Design, Logical Design – IoT Enabling Technologies – Domain Specific IoTs – IoT and M2M – IoT System Management with NETCONF –

YANG – IoT Platform Design – Methodology – IoT Reference Model – Domain Model – Communication Model – IoT Reference Architecture – IoT Protocols - MQTT, XMPP, Modbus, CANBUS and BACNet.

UNIT-V: IOT SYSTEM DESIGN 9

Basic building blocks of an IoT device – Raspberry Pi – Board – Linux on Raspberry Pi – Interfaces – Programming with Python – Case Studies: Home Automation, Smart Cities, Environment and Agriculture.

45 Periods

PRACTICAL EXERCISES:

- Programming Arithmetic and Logical Operations in 8051.
- Implementation of IoT using Python Programming.
- Study of ARM processor.
- Implementation of IoT using BLYNK - –Installation and Activation - Blinking an LED.
- Monitoring of temperature using sensor and Softcore Processors.
- Study of microcontrollers used in IoT.
- Logging of data in cloud using IoT.
- WAP for LED blink.
- Design of IoT System.

TOTAL: 60 Periods

COURSE OUTCOMES:

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

- Describe the architecture and features of 8051 and ARM processor.
- Develop a model of an embedded system.
- Explain the concepts of real time operating systems.
- Analyse the architecture and protocols of IoT.
- Integrate and apply the knowledge to solve practical problems for better output.
- Design an IoT based system for any application.

TEXT BOOKS:

1. Mohammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D.McKinlay, The 8051 Microcontroller and Embedded Systems Using Assembly and C, Second Edition, Pearson Education, 2008.(Unit – I)
2. Marilyn Wolf, Computers as Components – Principles of Embedded Computing System Design, Third Edition, Morgan Kaufmann, 2012. (Unit – II, III)
3. Arshdeep Bahga, Vijay Madisetti, Internet – of- Things – A Hands-on Approach, Universities Press, 2015. (Unit – IV, V)

REFERENCES:

1. Mayur Ramgir, Internet – of – Things, Architecture, Implementation and Security, First Edition, Pearson Education, 2020.
2. Lyla B.Das, Embedded Systems: An Integrated Approach, Pearson Education 2013.
3. Jane.W.S .Liu, Real – Time Systems, Pearson Education, 2003.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3564	3	3	3	-	3	-	-	-	-	-	-	3	2	2
EC3564	3	3	3	-	3	-	-	-	-	-	-	2	2	-
EC3564	3	3	2	-	3	-	-	-	-	-	-	2	2	-
EC3564	3	3	2	-	3	-	-	-	-	-	-	2	2	-
EC3564	3	3	3	-	3	-	-	-	-	-	-	2	2	-
EC3564	3	2	3	3	-	1	-	-	-	-	-	3	2	2
AVG	3	3	3	3	3	1	-	-	-	-	-	2	2	2

MD3564	MEDICAL EQUIPMENT LABORATORY	L	T	P	C
		0	0	3	1.5

OBJECTIVES:

The student should be made:

- To familiarize with the bio signals such as ECG and EEG.
- To provide practice on recording and analysis of different Bio potentials.
- To study the function of different Therapeutic equipment.
- To perform electrical safety measurements of any medical equipment.
- 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. Measurement of drug delivery system by using syringe pump.
10. Measurement of drug delivery system by using infusion pump.
11. Study of OPG-Orthopantomogram.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

CO1: Analyze the various Bio medical signals such as ECG, EEG.

CO2: Do recording and analysis of different Bio potentials.

CO3: Check the electrical safety of any medical equipment.

CO4: Explain about the concept and use of therapeutic equipment.

CO5: 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
1.	Short wave Diathermy	1 No
2.	Ultrasound diathermy	1 No
3.	Single parameter biotelemetry system	1 No
4.	Electrical Safety Analyzer	1 No
5.	Spirometry with associated analysis system	1 No
6.	ECG Simulator	1 No
7.	Medical stimulator	1 No
8.	Surgical diathermy with analyzer	1 No
9.	Audiometer	1 No
10.	Syringe pump	1 No
11.	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
CO1	3	2	1	1	1	-	-	-	-	1	1	-	1	-
CO2	3	2	1	1	1	-	-	-	-	1	1	-	1	-
CO3	3	2	1	1	1	-	-	-	-	1	1	-	1	-
CO4	3	2	1	1	1	-	-	-	-	1	1	-	1	-
CO5	3	2	1	1	1	-	-	-	-	1	1	-	1	-
Avg.	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**1**	**1**	**-**	**1**	**-**

MD3565 DISCRETE TIME SIGNAL PROCESSING LABORATORY L T P C

0 0 3 1.5

OBJECTIVES:

The student should be made:

- To understand the fundamentals of discrete-time signal processing and its applications.
- To analyze and implement signal processing operations like convolution, correlation, and frequency domain analysis.
- To design and implement digital filters (FIR and IIR) for signal filtering and processing.
- To explore and practice signal sampling techniques like up-sampling and down-sampling.
- To gain practical knowledge of DSP processor architecture and its addressing modes.

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 IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.
7. Implement an Up-sampling and Down-sampling operation.

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 IIR Filters for Low pass, High pass, Band pass and Band stop filtering.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

CO1: Generate and visualize elementary discrete-time sequences such as impulse, step, and sinusoidal signals.

CO2: Analyze signal properties using auto-correlation and cross-correlation techniques.

CO3: Design and implement FIR and IIR filters for various applications like low-pass, high-pass, band-pass, and band-stop filtering.

CO4: Perform up-sampling and down-sampling operations for multi-rate signal processing.

CO5: Understand the architecture and functionalities of DSP processors for real time signal processing applications.

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

SNO	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1	PCs with Fixed/ Floating point DSP Processors (Kit/ Add-on Cards)	15 Units (2 Students per Batch)
2	**List of Software Required:** MATLAB or its equivalent software.	15 Users
3	Function Generators (1 MHz)	15
4	CRO (20 MHz)	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
CO1	3	2	1	1	1	-	-	2	2	1	1	1	3	-
CO2	2	2	2	2	3	-	2	2	2	-	3	1	3	-
CO3	3	2	1	2	-	-	-	2	2	1	3	-	3	-
CO4	2	2	2	3	-	-	-	2	2	2	3	-	3	-
CO5	3	-	2	2	3	-	-	2	2	3	3	2	3	-
Avg.	**2.6**	**2**	**1.6**	**2**	**2.3**	**-**	**2**	**2**	**2**	**1.8**	**3.3**	**1.3**	**3**	**-**

MD3661 MEDICAL IMAGING TECHNIQUES L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the concepts on Radiography, Fluoroscopy, and Angiography.
- To examine the principles and applications of Computed Tomography.
- To obtain knowledge on the principle and construction of MRI and spectroscopy.
- To comprehend the application of radioisotopes and infrared imaging methods in the field of medicine.
- To assess the working principle of ultrasound in imaging the body.

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. BlockDiagram 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 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.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

CO1: Gain knowledge on medical imaging methods such as X-Ray and fluoroscopy.

CO2: Apply a detailed understanding of Computed Tomography.

CO3: Understand the principles of MRI and spectroscopy.

CO4: Outline the application of radioisotopes and infrared imaging methods in healthcare.

CO5: Analyze the difference between normal ultrasound images and artifacts.

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. Khandpur R.S, “Handbook of Biomedical Instrumentation”, Tata McGraw – Hill, 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
CO1	3	-	-	-	-	1	-	-	-	1	-	1	2	2
CO2	3	2	-	-	-	1	-	2	-	-	-	-	2	2
CO3	3	-	-	-	-	1	1	-	-	-	-	-	2	2
CO4	3	2	-	2	-	1	-	-	-	-	-	-	2	2
CO5	3	-	-	-	1	1	-	-	-	-	-	-	2	2
Avg	**3**	**2**	**-**	**2**	**1**	**1**	**1**	**2**	**-**	**1**	**-**	**1**	**2**	**2**

MD3662 HOSPITAL ADMINISTRATION AND MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To understand the fundamentals of hospital administration and management.
- To identify the importance of human resource management in hospital.
- To know the market related research process.
- To explore various information systems and relative supportive services.
- To learn the quality and safety aspects in hospital.

UNIT – I: OVERVIEW OF HOSPITAL ADMINISTRATION 9

Distinction between Hospital and Industry, Challenges in Hospital Administration – Hospital Planning – Equipment Planning- AMC – Functional Planning - Current Issues in Hospital Management - Telemedicine - Bio-Medical Waste Management

UNIT – II: HUMAN RESOURCE MANAGEMENT IN HOSPITAL 9

Principles of HRM – Functions of HRM – Profile of HRD Manager – Tools of HRD – Human Resource Inventory – Manpower Planning. Different Departments of Hospital, Recruitment, Selection, Training Guidelines –Methods of Training – Evaluation of Training – Leadership grooming and Training, Promotion – Transfer.

UNIT – III: MARKETING RESEARCH & CONSUMER BEHAVIOUR 9

Marketing information systems - assessing information needs, developing & disseminating information - Market Research process - Other market research considerations - Consumer Markets & Consumer Buyer behaviour - Model of consumer behaviour - Types of buying decision behaviour - The buyer decision process - Model of business buyer behaviour - Major types of buying situations - global marketing in the medical sector - WTO and its implications.

UNIT – IV: HOSPITAL INFORMATION SYSTEMS & SUPPORTIVE SERVICES 9

Management Decisions and Related Information Requirement - Clinical Information Systems - Administrative Information Systems - Support Service Technical Information Systems – Medical Transcription, Medical Records Department – Central Sterilization and Supply Department – Pharmacy– Food Services - Laundry Services

UNIT – V: QUALITY AND SAFETY ASPECTS 9

Quality system – Elements, implementation of quality system, Documentation, Quality auditing, International Standards ISO 9000 – 9004 – Features of ISO 9001 – ISO 14000 – ISO 13485, Environment Management Systems. NABA, JCI, NABL, NABH. Security – Loss Prevention – Fire Safety – Alarm System – Safety Rules. Health Insurance & Managing Health Care - Medical Audit – Hazard and Safety in a hospital Setup.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Understand the importance of planning and biomedical waste disposal concept.

CO2: Explain the principles, practices and Human Resource management in Hospital.

CO3: Explore the concept of marketing research in hospitals.

CO4: Acquire knowledge on Hospital information systems.

CO5: Comprehend the quality aspect specified by the international standards.

TEXT BOOKS:

1. R.C.Goyal, “Hospital Administration and Human Resource Management”, PHI–4th Edition,2006.
2. G.D.Kunders, “Hospitals – Facilities Planning and Management”, TMH, New Delhi
3. 5th edition Reprint 2007.

REFERENCE BOOKS:

1. Peter Berman, “Health Sector Reform in Developing Countries”, Harvard University Press, 1995.
2. Norman Metzger, “Handbook of Health Care Human Resources Management”, Aspen Publication Inc. Rockville, Maryland, USA, 2nd Edition 1990.
3. Arnold D. Kalcizony & Stephen M.Shortell, “Health Care Management”, 6th Edition, 2011.
4. Blane, David, Brunner, Eric , “Health and Social organization: Towards a health policy for the 21st century”, Calrendon Press, 1994.

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

MD3663 MEDICAL IMAGE PROCESSING L T P C

3 0 0 3

OBJECTIVES:

The student should be able:

- Learn the fundamental concepts of medical Image Processing techniques.
- Understand the concepts of various image intensity transformation and filtering operations.
- Be familiar in the techniques of segmentation and restoration of medical images.
- Gain knowledge in medical image registration and visualization.
- Be familiar with the application of medical image analysis.

UNIT – I: FUNDAMENTALS OF MEDICAL IMAGE PROCESSING AND TRANSFORMS 9

Overview of Image Processing system and human Visual system- Image representation – pixel and voxels, Gray scale and color models- Medical image file formats- DICOM, ANALYZE 7.5, NIFTI and INTERFILE- Discrete sampling model and Quantization- Relationship between the pixels, Arithmetic and logical operations- Image quality and Signal to Noise ratio- Image Transforms- 2D DFT, DCT.

UNIT – II: ENHANCEMENT TECHNIQUES 9

Gray level transformation- Log transformation, Power law transformation, Piecewise linear transformation. Histogram processing- Histogram equalization, Histogram Matching. Spatial domain Filtering-Smoothing filters, sharpening filters. Frequency domain filtering- Smoothing filters, Sharpening filters- Homomorphic filtering -Medical image enhancement using Hybrid filters- Performance measures for enhancement techniques.

UNIT – III: SEGMENTATION AND RESTORATION TECHNIQUES 9

ROI definition -Detection of discontinuities–Edge linking and boundary detection – Region based segmentation- Morphological processing, Active contour models. Image Restoration- Noise models– Restoration in the presence of Noise – spatial filtering, Periodic noise reduction by frequency domain filtering- linear position- Invariant degradation- Estimation of degradation function, Inverse filter, Weiner filtering.

UNIT – IV: REGISTRATION AND VISUALISATION 9

Registration–Rigid body transformation, principal axes registration, and feature based. Visualisation-Orthogonal and perspective projection in medicine, Surface based rendering, Volume visualization in medical image. Significance of registration of various imaging modalities and appraise the concepts of image visualization.

UNIT – V: APPLICATIONS OF MEDICAL IMAGE ANALYSIS 9

Medical Image compression- DCT and Wavelet transform based image compression, Pre-processing of medical images -Retinal images, Ultrasound –liver, kidney, Mammogram. Segmentation of ROI -blood vessels, lesions, tumour, lung nodules, feature extraction- shape and texture, Computer aided diagnosis system – performance measures (confusion matrix, ROC, AUC).

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Explain the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.

CO2: Apply various techniques of smoothing, sharpening and enhancement on images.

CO3: Analyze the restoration concepts and filtering techniques.

CO4: Explore the basics of segmentation, features extraction.

CO5: Enumerate the compression and recognition methods.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, Pearson, Fourth Edition, 2017.
2. Isaac N. Bankman, Handbook of Medical Image Processing and Analysis, 2nd Edition, Elsevier, 2009.
3. Wolfgang Birkfellner, Applied medical Image Processing: A Basic course, CRC Press, 2011 .

REFERENCE BOOKS:

1. Atam P.Dhawan, Medical Image Analysis, Wiley-Interscience Publication, NJ, USA 2003.
2. Rangaraj M. “Rangayyan, Biomedical Image Analysis”, 1st Edition, CRC Press,Published December 30, 2004.

3. Joseph V.Hajnal, Derek L.G.Hill, David J Hawkes, “Medical image registration”, Biomedical Engineering series, CRC press,2001

4. Milan Sonka, 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**	-
CO 1	3	3	1	1	1	-	-	-	-	-	-	1	1	-
CO 2	3	3	1	1	1	-	-	-	-	-	-	1	1	-
CO 3	3	3	1	1	1	-	-	-	-	-	-	1	1	-
CO 4	3	3	1	1	1	-	-	-	-	-	-	1	1	-
CO 5	3	3	1	1	1	-	-	-	-	-	-	1	1	-
Avg.	**3**	**3**	**1**	**1**	**1**	-	-	-	-	-	-	1	**1**	-

MD3664 MEDICAL IMAGE PROCESSING LABORATORY L T P C

0 0 3 1.5

OBJECTIVES:

The student should be made:

- To practice the basic image processing techniques.
- To compute the spatial filtering techniques.
- To understand the concepts of frequency domain filtering.
- To know the concepts of image standards and analysis.
- To explore the applications of medical image processing techniques.

LIST OF EXPERIMENTS:

1. Display of color and grayscale Images.
2. Binary to Gray and Gray to binary conversion of images
3. Conversion between color spaces.
4. Histogram Equalization of image.
5. Image noise removal using spatial filtering process.
6. Non-linear Filtering of Image.
7. Edge detection using Operators.
8. Study of DICOM and NifTi standards.
9. Segmentation of Medical Image.
10. Feature extraction of medical images using entropy
11. Medical Image Compression techniques.
12. Medical image fusion.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

CO1: Perform fundamentals in the image processing operations.

CO2: Compute pixel level manipulations of the image.

CO3: Estimate the harmonic level analysis of the image.

CO4: Understand the medical image store and transmit procedures.

CO5: Apply image processing technique to medical standards.

.

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 or any equivalent software with Image processing tool box	15

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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

MD3645	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: 60

COURSE OUTCOMES:

The student should be able to:

CO1: Formulate a real world problem, identify the requirement and develop the design solutions.

CO2: Express the technical ideas, strategies and methodologies.

CO3: Utilize the new tools, algorithms, techniques that contribute to obtain the Solution of the project.

CO4: Test and validate through conformance of the developed prototype and analysis the cost effectiveness.

CO5: 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**
CO 1	2	3	2	3	-	1	1	1	3	-	1	1	3	3
CO 2	1	-	3	2	1	-	-	-	3	1	-	-	2	2
CO 3	-	2	3	-	3	-	-	-	3	-	1	1	3	3
CO 4	1	2	2	3	-	-	1	-	3	-	-	1	1	2
CO 5	-	1	-	-	-	1	-	-	3	3	1	1	1	1
Avg.	**1.3**	**2**	**2.5**	**2.7**	**2**	**1**	**1**	**1**	**3**	**2**	1	**2**	**2**	**2.2**

EN3649 PROFESSIONAL COMMUNICATION LABORATORY **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 **6**

English for competitive exams —general awareness of current affairs – multiple choice – cloze – vocabulary structure.

UNIT- II **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 **6**

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

UNIT- IV **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 **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.

OUTCOMES:

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

CO1: Make effective presentations and participate confidently in Group Discussions

CO2: Attend job interviews and interacting in different situations.

CO3: Able to write business reports, proposals and related correspondence.

CO4 : 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

1. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 Edition, 2015
2. English for success in Competitive exams. Philip Sunil Solomon – OUP 2009.

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

1 - low, 2 – medium, 3 – high, '-' – no correlation

MD3761 FUNDAMENTALS OF HEALTH CARE ANALYTICS L T P C

3 0 0 3

OBJECTIVES:

- To understand the statistical methods for the design of biomedical research.
- To comprehend the fundamental of mathematical and statistical theory in the application of Healthcare
- To apply the regression and correlation analyze in the healthcare data.
- To explore Meta-analysis and variance analysis.
- To gain sound knowledge about the constructional and functional characteristics of hearing implants.
- To analyze real time applications of health care systems.

UNIT – I: INTRODUCTION 9

Introduction, Computers and bio statistical analysis, Introduction to probability, likelihood & odds, distribution variability. Finding the statistical distribution using appropriate software tool like R/ Python.

UNIT II STATISTICAL PARAMETERS 9

Statistical parameters p-values, computation, level chi square test and distribution and hypothesis testing -single population proportion, difference between two population proportions, single population variance, tests of homogeneity. Testing of statistical parameters using appropriate software R / Python.

UNIT III REGRESSION AND CORRELATION ANALYSIS 9

Regression model, evaluating the regression equation, correlation model, correlation coefficient. Finding regression, correlation for the data using appropriate software like R / Python

UNIT IV ANALYSIS OF VARIANCE 9

META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment. Testing the variance using appropriate software tool like R / Python.

UNIT V CASE STUDIES 9

Epidemical reading and interpreting of epidemical studies, application in community health, Case study on Medical Imaging like MRI, CT. Case study on respiratory data, Case study on ECG data.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Define the new and existing statistical methodology for their research problem.

CO2: Describe the p- values for different statistical test.

CO3: Analyze the biomedical research data and able to report the study results.

CO4: Enumerate the Meta analysis and variance analysis.

CO5: Describe problems of human health and disease for the interest of advancing the public's Health.

TEXT BOOKS:

1. Wayne W. Daniel, Biostatistics-A Foundation for Analysis in the Health Sciences, John Wiley & Sons Publication, 10th Edition, 2013.
2. Peter Armotage, Geoffrey Berry and J.N.S.Mathews, Statistical methods in Medical Research, Wiley-Blackwell, 4th Edition, 2001.
3. Bernard Rosner. Fundamentals of biostatistics. Nelson Education, 8th Edition 2015 ISBN:978-1-305-26892-0

REFERENCE BOOKS:

1. Marcello Pagano and Kimberlee Gauvreu, Principles of Biostatistics, Chapman and Hall/CRC, 2ndEdition, 2018.
2. Ronald N Forthofer and EunSul Lee, Introduction to Biostatistics, Academic Press, 1st Edition, 2014.
3. Animesh K. Dutta, Basic Biostatistics and its Applications, New Central Book Agency, 1st Edition, 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**
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	1	1	-	-	-	-	-	1	1	-
CO 4	3	1	1	1	1	1	-	-	-	-	-	1	1	-
CO 5	3	1	1	1	1	1	-	-	-	-	-	1	1	-
Avg.	**3**	**1**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	-	**1**	**1**	**-**

BA3711	HUMAN VALUES AND ETHICS	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To introduce and educate the students on the concept of Human Values.
- To support students to understand the need, basic guidelines, content and process of value education.
- To facilitate the students to understand harmony at all the levels of human living.
- To help the students to understand social ethics and live accordingly.
- To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life.

UNIT I: HUMAN VALUES **6**

Human value – needs, Values and its Types - Ethics. 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.

UNIT II: VALUE EDUCATION **6**

Value Education: Definition, Concept and Need for Value Education. The Content and Process of Value Education. Basic Guidelines for Value Education.

UNIT III: HARMONY **6**

Harmony in the Family- the basic unit of human interaction, Trust and Respect, Harmony of the Self with the Body: Self -regulation and Health. Harmony in Society: Dimensions system of Human Order. Harmony in Nature: The Four Orders in Nature.

UNIT IV: SOCIAL ETHICS **6**

The Basics for Ethical Human conduct - Defects in Ethical Human Conduct - Holistic and Universal order - Universal Human Order and Ethical Conduct.

UNIT V: ETHICS IN PROFESSION **6**

Professional Integrity, Respect & Equality, Privacy, Positive co-operation, Respecting

the competence of other professions. - Business ethics - Environmental ethics - Internet ethics - Engineers as expert witnesses and advisors.

TOTAL HOURS: 30

OUTCOMES:

1. Students will be able to understand the significance of value inputs in a classroom and start applying them in their life and profession.
2. Students will be able to understand the need, basic guidelines, content and process of value education.
3. Students will be able to the role of a human being in ensuring harmony in society and nature.
4. Students will be able to understand social ethics.
5. Students will be able to Distinguish between ethical and unethical practices and start working out the strategy to actualize a harmonious environment wherever they work.

REFERENCES:

1. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill – 2013.
2. Ethics in Engineering by Mike W. Martin and Roland Schinzinger - Tata McGraw-Hill - 2003.
3. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books First Edition 2009.
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).
6. R. Subramanian, ‘Professional Ethics’ Oxford University Press, 2nd Edition 2017
7. R. S. Nagarazan, ‘A Textbook on Professional Ethics and Human Values’ New Age International Publishers, 2015.
8. World Community Service Centre, “Value Education", Vethathiri publications, Erode, 2011.
9. Langford, Duncan (EDT): Internet Ethics, London, Macmillan Press Ltd., 2000.
10. Erwann, M. David, Michele S. Shauf, Computers, Ethics and Society, Oxford University Press, 2003.
11. Suresh Jayshree, 2003, Human Values and Professional Ethics, ,S. Chand

Publishing, Third Revised Edition.

E-BOOK :

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics, Excel Books First Edition 2009.
2. R. S. Nagarazan, ‘A Textbook on Professional Ethics and Human Values’ New Age International Publishers, 2015.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1							1	
CO2			1					
CO3							1	
CO4				1				
CO5				2				
Avg			1	2			1	

EC3763	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Study about uninformed and Heuristic search techniques
- Learn techniques for reasoning under uncertainty
- Introduce Machine Learning and supervised learning algorithms
- Study about ensembling and unsupervised learning algorithms
- Learn the basics of deep learning using neural networks
- To apply the concept of adaptive filter and multirate signal processing for various applications.

UNIT-I: Introduction to AI **9**

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP)

UNIT-II: PROBABILISTIC MODELS IN AI **9**

Acting under uncertainty – Bayesian inference – naive bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks.

UNIT-III: SUPERVISED LEARNING **9**

Introduction to machine learning – Linear Regression Models: Least squares, single & multiple variables, Bayesian linear regression, gradient descent, Linear Classification Models: Discriminant function – Probabilistic discriminative model - Logistic regression, Maximum margin classifier – Support vector machine, Decision Tree, Random forests.

UNIT-IV: ENSEMBLE TECHNIQUES AND UNSUPERVISED LEARNING **9**

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning - bagging, boosting, stacking, Unsupervised learning: K-means, Instance Based Learning: KNN, Gaussian mixture models and Expectation maximization.

UNIT-V: LEARNING & GRAPHICAL MODELS 9

Evolutionary Learning - The Genetic Algorithms (GA)-Reinforcement Learning -Decision Trees, Markov Random Fields - Hidden Markov Models (HMMS) - Markov Chain Monte Carlo (MCMC) Methods - Deep Belief Networks (DBN)

TOTAL : 45 Periods

PRACTICAL EXERCISES:

- Implementation of Uninformed search algorithms (BFS, DFS)
- Implementation of Informed search algorithms (A*, memory-bounded A*)
- Implement naïve Bayes models
- Implement Bayesian Networks
- Build Regression models
- Build decision trees and random forests
- Build SVM models
- Implement ensembling techniques
- Implement clustering algorithms
- Implement EM for Bayesian networks
- Build simple NN models
- Build deep learning NN models

COURSE OUTCOMES:

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

- Use appropriate search algorithms for problem solving
- Apply reasoning under uncertainty
- Build supervised learning models
- Build ensembling and unsupervised models
- Build deep learning neural network models
- Propose the system for given application

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, Fourth Edition, Pearson Education, 2021.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Fourth Edition, 2020.

REFERENCES:

1. Dan W. Patterson, “Introduction to AI and ES”, Pearson Education,2007
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”, McGraw Hill, 2008
3. Patrick H. Winston, "Artificial Intelligence", Third Edition, Pearson Education, 2006
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013 (http://nptel.ac.in/)
5. Christopher M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006
6. Tom Mitchell, “Machine Learning”, McGraw Hill, 3rd Edition,1997.
7. Charu C. Aggarwal, “Data Classification Algorithms and Applications”, CRC Press, 2014
8. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012.
9. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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

MD3762 MEDICAL ELECTRONICS SYSTEM DESIGN LABORATORY **L T P C 0 0 3 1.5**

OBJECTIVES:

- 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 DC regulator circuit for Low Power Wearable Devices.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Understand the usage of electronic components and medical sensors used in medical electronics system.

CO2: Create electronic circuits for various signal processing applications in medical electronic system

CO3: Conduct experiments using designed and assembled circuits for medical applications..

CO4: Design and simulate various electronic PCB required for prototyping and testing using software tools and testing equipment.

CO5: Identify, formulate, and solve engineering problems associated with assembly and testing of Medical electronic circuits.

LIST OF LAB EQUIPMENTS FOR A BATCH OF 30 STUDENTS

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**
CO1	1	2	-	-	-	-	-	-	-	-	-	-	3	1
CO2	1	1	3	2	-	-	-	-	2	2	-	-	3	1
CO3	-	1	-	3	-	-	-	-	2	1	-	-	2	1
CO4	1	-	3	2	3	-	-	-	2	2	-	-	3	2
CO5	1	3	3	2	-	-	-	-	2	-	-	-	3	1
Avg.	**1**	**1.8**	**3**	**2.3**	**3**	**-**	**-**	**-**	**2**	**1.7**	**-**	**-**	**2.8**	**1.2**

MD3743 HOSPITAL EQUIPMENT TRAINING 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:

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

- 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.

TOTAL PERIODS: 30

OUTCOMES:

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

CO1: Understand the importance of engineering services in medical field.

CO2: Communicate with other health professionals in a respectful and responsible manner.

CO3: Recognize the importance of inter-professional collaboration in healthcare.

CO4: Trouble shooting, Maintenance and calibration of medical machines.

CO5: 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
CO1	-	-	3	3	-	-	-	-	3	-	-	-	3	2
CO2	-	-	-	-	-	-	-	3	3	3	-	-	3	2
CO3	-	-	-	3	-	3	3	3	3	3	-	-	3	2
CO4	3	-	3	-	-	3	3	3	3	-	-	3	3	2
CO5	-	-	3	3	-	3	3	3	3	3	-	3	3	2
Avg	3	-	3	3	-	3	3	3	3	3	-	3	3	2

MD3841	PROJECT WORK	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

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Use the fundamental knowledge and skills in engineering and apply it effectively on a project.

CO2: Plan and manage the time effectively as a team.

CO3: Orally present and demonstrate your product to peers, academics, general and industry community.

CO4: Consider the business context and commercial positioning of designed devices or systems.

CO5: Apply knowledge of the 'real world' situations that a professional engineer can encounter.

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
CO1	3	3	3	3	2	2	3	-	3	3	3	3	3	3
CO2	3	3	3	3	3	2	3	2	3	3	3	3	3	3
CO3	3	3	3	3	2	2	-	3	2	3	3	3	3	3
CO4	3	3	3	3	3	2	-	3	3	3	3	3	3	3
CO5	3	3	-	3	-	2	-	3	2	3	2	1	2	-
Avg.	**3**	**3**	**3**	**3**	**2.5**	**2**	**3**	**2.8**	**2.6**	**3**	**2.8**	**2.6**	**3**	**3**

MANAGEMENT – ELECTIVE

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	MAN101	Principles of Management	HSMC	2	0	0	2	2
2.	MAN102	Total Quality Management	HSMC	2	0	0	2	2
3.	MAN103	Human Resources Management	HSMC	2	0	0	2	2
4.	MAN104	Entrepreneurship Development	HSMC	2	0	0	2	2

MAN101 PRINCIPLES OF MANAGEMENT L T P C
2 0 0 2

OBJECTIVES:

- To study the principles of management, functions and their application in 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 of controlling and the various techniques involved in controlling.

UNIT I: INTRODUCTION TO MANAGEMENT 6

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. Current trends and issues in Management.

UNIT II: PLANNING 6

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management –types of strategies.

UNIT III: ORGANISING 6

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.

UNIT IV: DIRECTING 6

Motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – the process of communication – barrier in communication.

UNIT V: CONTROLLING 6

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.

TOTAL HOURS: 30

OUTCOMES:

1. Students will be able to have a clear understanding of managerial functions.
2. Students would have the knowledge to apply planning techniques and decision-making.
3. Understand the concept of Human Resource Management.
4. Students would be able to understand motivation, leadership and communication principles.
5. Students would be able to apply control techniques in the organization.

Textbooks:

1. Stephen P. Robbins & Mary Coulter, “Management”, 14th Edition, Pearson, 2017
2. AF Stoner, Freeman R.E and Daniel R Gilbert “Management”, 6th Edition, Pearson, 2004.

REFERENCES:

1. R.S.N. Pillai, S.Kala, Principles of Management, S. Chand Publishing, 2013.
2. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” 10th Edition, Pearson Education, 2016.
3. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.
4. Harold Koontz & Heinz Weihrich “Essentials of management” Tata Mc Graw Hill, 2006.
5. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 6th edition 2017.

CO-PO Mapping		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1		1							
CO2			2						
CO3						1			
CO4				1					
CO5			1						
Avg.		1	2	1		1			

MAN102 **TOTAL QUALITY MANAGEMENT** **L T P C**

2 0 0 0

OBJECTIVES:

- To understand the Total Quality Management Concepts and Dimensions of Customers quality.
- To familiarise the various contributions of Quality Gurus.
- To understand the Framework of Quality Management.
- To educate about tools and techniques in Quality Management.
- To impart knowledge to implement the Quality Management System.

UNIT–I: INTRODUCTION **6**

Introduction - Need for quality - Evolution of quality - Definition of quality, Benefits &Obstacles, Quality – vision, mission and policy statements - Attitude and involvement of top management, Customer Focus – customer perception - Customer retention. Introduction to SERVQUAL.

UNIT–II: OVERVIEW OF THE CONTRIBUTIONS **6**

Philosophies of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa - Concept of Quality circle

UNIT–III: TQM FRAMEWORK **6**

Culture, Leadership – Quality Council, Employee Involvement, Motivation, Empowerment,Recognition and Rewards, International/National Quality Awards.

UNIT–IV: TOOLS AND TECHNIQUES **6**

Six Sigma, Kaizen, 5S, 7QC Tools, Quality function deployment (QFD) – Benefits, Voice of customer, Information Organization, Building a House of Quality (HOQ), Bench marking and Poka-Yoke.

UNIT–V: QUALITY MANAGEMENT **6**

Quality Audits – Quality Council. ISO 9001:2015 (Quality Management) AS9100 (Aerospace), ISO 14001(Environment), ISO/TS 16949 (Automotive), ISO 17025 (Testing/FDA), TL 9000 (Telecommunication), ISO 13485 (Medical Devices), ISO 27001 (Information Security), ISO 29001 (Oil / Gas).

OUTCOMES:

1. Students will have an understanding of Quality Management concepts and Customers
2. Students will be able to apply Quality principles provided by the authors and implement.
3. Students will have an understanding of Framework of Quality Management.
4. Students will be able to apply tools and techniques to improve business process.
5. Students will be able to understand Quality System available.

REFERENCES:

1. James R. Evans, William M.Lindsay, "Total Quality Mangement"10 th Edition, Cengage, Phillippine Edition, 2019.

2. Ray Tricker, Quality Management Systems: A Practical Guide to Standards

3. Implementation, Routledge; 1st edition, 2019

4. 3.Poornima M. Charantimath, Total Quality Management, Pearson Education, 2 ndEdition,2017.

5. Dale H. Besterfield, Carol Besterfield, Michna, Glen H. Besterfield, Mary Besterfield,

6. Sacre, Hermant, Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management,

7. Revised 4 th Edition, Pearson Education, 2013.

8. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, 2 nd Edition 2010.

9. 6.Douglas C. Montgomory, Introduction to Statistical Quality Control, Wiley Student

10. Edition, 7 th Edition, Wiley India Pvt Limited, 2012.

11. Indian Standards – Quality management systems – Guidelines for performance

12. improvement (Fifth Revision), Bureau of Indian standards, New Delhi.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1							
CO2				1				
CO3				1				
CO4		2						
CO5				1				
Avg.	1	2		1				

MAN103	HUMAN RESOURCES MANAGEMENT	L	T	P	C
		2	0	0	2

OBJECTIVES:

- To enable students to gain knowledge on Human resource management concepts and principles.
- To familiarise students about HRP process and Job Analysis.
- To illustrate the techniques and tools for Training and Development and Performance appraisal.
- Students will be able to illustrate the techniques and tools for compensation.
- To understand concepts of Performance evaluation, Industrial Relations System andGrievance redressal mechanism.

UNIT – I: INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 6

Meaning – Definition – Nature – Scope and significance – Evolutionary growth of HRM – Functions of HRM - Role of Human resource manager – Personnel Management vs HRM.

UNIT – II: TALENT MANAGEMENT 6

Job Analysis – Job description & specification - Human Resource Planning – Forecasting human resource requirement –Recruitment - Selection –Induction.

UNIT–III: TRAINING AND DEVELOPMENT 6

Need for Training – Process -Types of Training methods – On the job & Off the job - Purpose – Benefits – Management development programmes – Training vs Development -Effectiveness of training

UNIT – IV: COMPENSATION MANAGEMENT 6

Introduction – Compensation – Forms & Types of compensation – Determinants of compensation – Components of Pay structure – Significance in Employee morale

UNIT – V: PERFORMANCE MANAGEMENT AND CONTROL PROCESS 6

Performance Management System – Process – Appraisal methods – Evaluation of

managerial Implications – Control process – Importance – Methods – Requirement of effective control systems

Total Hours : 30

OUTCOMES:

1. Students will be able to gain knowledge on Human resource management concepts and principles.
2. Students will be able to do human forecasting and handle HRM issues in the context of outsourcing.
3. Students will be able to design and implement appropriate Training and Development programmes.
4. Students will be able to develop relevant Compensation system to meet individual and organisational strategic needs.
5. Students can develop Performance appraisal system and effectively handle Disciplinary andgrievance mechanisms.

REFERENCES:

1. Gary Dezzler & Biju Vaarkey, Human Resource Management, Pearson 16th edition 2020
2. S S Khanka, Human Resource Management (Text and Cases), S. Chand Publishing, 2019.
3. Decenzo and Robbins, Fundamentals of Human Resource Management, Wiley, 11th Edition,2013.
4. Luis R. Gomez-Mejia, David B. Balkin, Robert L Cardy, Managing Human Resource, PHILearning, 2012.
5. Bernadin, Human Resource Management, Tata Mc Graw Hill, 8th Edition 2012.
6. Wayne Cascio, Managing Human Resource, Mc Graw Hill, 9th Edition, 2012.
7. Ivancevich, Human Resource Management, Mc Graw Hill, 2012.
8. Uday Kumar Haldar, Juthika Sarkar. Human Resource Management, Oxford 2012.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				1				
CO2		1						
CO3				1				
CO4		1						
CO5				1				
Avg.		1		1				

MAN104 ENTERPRENEURSHIP DEVELOPMENT L T P C

2 0 0 2

OBJECTIVES:

1. Develop and strengthen entrepreneurial qualities and entrepreneur's role in economic growth
2. Impart understanding on Entrepreneurial Training and Development Programs.
3. Develop understanding on the business environment and to manage projects.
4. Create an understanding on project finance and accounting principles.
5. Create awareness on entrepreneurial support offered through government agencies and schemes.

UNIT – I: INTRODUCTION 6

Entrepreneur – Types of Entrepreneurs – Entrepreneurship as a Career – Entrepreneurial Personality - women entrepreneurship, rural and urban entrepreneurship, Entrepreneur – Knowledge and Skills of Entrepreneur. Difference between Entrepreneur and Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT–II: ENTREPRENEURIALMOTIVATION 6

Major Motives Influencing an Entrepreneur, motivation theories-Maslow's Need Hierarchy Theory – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT – III: BUSINESS ENVIRONMENT AND PROJECT MANAGEMENT 6

Business Environment - Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT–IV: FINANCING AND ACCOUNTING 6

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, and Management of working Capital. Accounting – Double Entry system of accounting.

UNIT–V: SUPPORT TO ENTREPRENEURS **6**

Entrepreneur Support Organizations - Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL HOURS : 30

OUTCOMES:

1. Gain knowledge and skills needed to run a business.
2. Understanding the concept on entrepreneurial motivation.
3. Formulate project proposals based on understanding on business environment.
4. Evaluate accounting and financial aspects of business.
5. Understanding on project funding and support agencies.

TEXT BOOKS:

1. Khanka. S.S"Entrepreneurial Development" S.Chand&Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, "Entrepreneurship – Theory, Process and Practice", 10th Edition, Cengage Learning, 2017

REFERENCE BOOKS:

1. Hisrich R D, Peters M P, "Entrepreneurship" 10th Edition, Tata McGraw-Hill, 2017.
2. Mathew J Manimala, "Entrepreneurship theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
3. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
4. EDII "Faculty and External Experts – A Hand Book for New Entrepreneurs Publishers:
5. Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	1							
CO2				1				
CO3				1				
CO4		2						
CO5				1				
Avg	1	2		1				

MANDATORY COURSES – I

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	MBA101	Introduction to Gender Studies	MC	3	0	0	3	0
2.	MEN101	Elements of Literature	MC	3	0	0	3	0
3.	MBA102	Patent Drafting for Beginners	MC	3	0	0	3	0
4.	MBA103	Industrial Psychology	MC	3	0	0	3	0
5.	MBA104	Indian Constitution	MC	3	0	0	3	0

MBA101	INTRODUCTION TO GENDER STUDIES	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To provide awareness on how gender operates on Institutional and cultural context.
- To understand about gender roles in society.
- To understand the institutions of family and its influence on women's status.
- To educate students on the gender issues.
- To familiarize students with women development with gender perspective.

UNIT – I: INTRODUCTION TO WOMEN STUDIES 9

Women & Gender Studies Perspectives & Practices - Need, Scope and challenges of Women's Studies – Need for Gender Sensitization - Women's Movements – global and local - National Committees and Commissions for Women.

UNIT-II: FEMINIST THINKERS AND THEORIES 9

Liberal Feminism, Marxist Feminism, Radical Feminism, Socialist Feminism, Indian Feminism, Black Feminism, Eco-Feminism - New Feminist Debates- Contemporary Contestations - Feminist thinkers in 18th, 19th, 20h and 21st Century.

UNIT - III: WOMEN, WORK AND EMPLOYMENT 9

Concept of Work – Productive and non – productive work – Use value and market value - Gender Division of Labour – Mode of Production – Women in organized and unorganized sector - New Economic Policy and its impact on Women's Employment – Globalization – Structural Adjustment Programs.

UNIT - IV: GENDER AND ENTREPRENEURSHIP 9

Concept and meaning, Importance of Entrepreneurship, Entrepreneurial traits, Factors contributing to Entrepreneurship, enabling environment, small Enterprises, women in agri-business - Gender and emerging Technology – Impact -Self-help Groups and Micro Credit.

UNIT - V: WOMEN DEVELOPMENT **9**

Theories of Development, Alternative approaches – Women in Development (WID), Women and Development (WAD) and Gender and Development (GAD) - Empowerment- Concept and indices: Gender Development Index (GDI), Gender Inequality Index (GII), Global Gender Gap Index (GGGI) - Women Development approaches in Indian Five – Year Plans - Women and leadership– Panchayati Raj and Role of NGOs and Women Development - Sustainable Development Goals, Policies and Programmes.

TOTAL HOURS : 45

OUTCOMES:

1. Students will have an understanding on gender and its operations on Institutional and cultural context.
2. Students will be able to understand about gender roles in society.
3. Students will be able to understand the institutions of family and its influence on women's status.
4. Students will be educated on the gender issues.
5. Students will be familiarized on women development with gender perspective.

REFERENCES:

1. Susan Shaw and Janet Lee, Women's Voices, Feminist Visions, McGraw Hill Pub, 6 th edition, 2014
2. Rege, Sharmila (ed), Sociology of Gender: The Challenge of Feminist Sociological
3. Knowledge, Sage, New Delhi, 2003.
4. Bonnie G. Smith,2013Women's Studies:the Basics,Routledge
5. Uma Chakravarti. Gendering Caste: Through a Feminist Lens. Sage, 2018.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1							1	
CO2							1	
CO3				1				
CO4							1	
CO5							1	
Avg.				1			1	

MEN101 **ELEMENTS OF LITERATURE** **L T P C**

3 0 0 0

OBJECTIVE

1. To make the students aware of the finer sensibilities of human existence through an art form
2. To enable students to appreciate different forms of literature
3. To help students understand that literature is an expression of life's experience.
4. To improve the aesthetic sense of the students by exposing them to various forms of literature
5. To improve the creative abilities of students by giving them opportunities to review forms of literature.

UNIT – I: Introduction to Elements of Literature **9**

- Reading, thinking, discussing and writing skills
- Finer sensibility for better human relationship
- Understanding of the problem of humanity without bias
- Space to reconcile and get a cathartic effect

Assessment- Declamation Solioquy

UNIT – II: Elements of fiction **9**

- Plot, character and perspective
- Analysing works of literature
- Character analysis
- Short story reading

Assessment- Short Story Analysis

UNIT – III: Elements of poetry **9**

- Emotions and imaginations
- Figurative language
- Simile, metaphor, conceit, symbol, pun and irony
- Personification and animation

Assessment – Appreciation Poetry.

UNIT – IV: Elements of drama **9**

- Drama as representational art
- Content, mode and elements
- Features of tragedy, comedy and satire

Assessment – Presenting a play/Skit/ Street P

UNIT – V: Impact of literature on Society **9**

- Translation of original literature in English
- Comparative literature
- Expression of finer feelings in different forms of literature.
- Influence of literature in society

Assessment- Project: Under the guidance of the teachers, the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context (sociological, psychological, historical, autobiographical etc).

COURSE OUTCOMES

At the end of the course, learners will be able

CO1: To understand the relevance of literature in human life.

CO2: To appreciate the aspects of literature in developing finer sensibilities.

CO3: To enhance reading, thinking, discussing opinions and to understand finer feelings.

CO4: To identify the creative uses of language in literary texts.

CO5: To write reviews and comments about forms of literature.

Reference Book

- Seasons of Life: A Poetic Anthology (Literary Classics) by Nigel Collins, Jim Herrick, John Pearce (ISBN: 9781573927710) Web Link :https://www.amazon.co.uk/Seasons-Life-Anthology Literary-Classics/dp/1573927716
- New One-Act Plays for Acting Students: A New Anthology of Complete One-Act Plays for One, Two or Three Actors Paperback – by Norman Bert (Author), Deb Bert (Editor) Web Link : https://www.amazon.in/New-One-Act-Plays-Acting

Students/dp/1566080843 .

- Student Text (Drama Essentials: An Anthology of Plays) Paperback – by Matthew C. Roudane (Editor) Web Link : https://www.amazon.in/Drama-Essentials-Student Anthology-Plays/dp/0618474773
- World’s Greatest Short stories Publisher. Wilco publishing house.

MBA102	PATENT DRAFTING FOR BEGINNERS	L	T	P	C
		3	0	0	0

OBJECTIVES:

- To recognize the importance of IP and to educate the pupils on basic concepts of Intellectual Property Rights.
- To identify the significance of practice and procedure of Patents.
- To make the students to understand the statutory provisions of different forms of IPRs in simple forms.
- To learn the procedure of obtaining Patents, Copyrights, Trade Marks & Industrial Design.
- To enable the students to keep their IP rights alive.

Unit – I Understanding and Over view of the IPR Regine 9

Introduction, types of intellectual property- Industrial property, Artistic and literary Property, Need for intellectual property rights, Rationale for protection of IPR, Impact of IPR on development, health, agriculture, and genetic resources, IPR in India- Genesis and development, IPR in abroad- some important examples of IPR, International organizations, agencies, and treaties.

Unit- II Patents 9

Need for patent, Macro-economic impact of the patent system, Classification of patents in India, Classification of patents by WIPO, Categories of Patent, Special Patents, Patenting Biological products, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the international patent system, Utility models, Case Study.

Unit-III Copyright 9

Rights and protection covered by copy right- law of copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copyright ownership issues, obtaining copyright registration, notice of copy rights, international copyright law, infringement of copy right under copyright Act.

Unit- IV Trademarks and Trade Secret 9

Overview of Trademarks & Trade Secret, Importance of Trademarks & Trade secret, Rights of Trademark & Trade Secret, Types of Trademarks, Registration process for Trademark &Trade Secret, Duration of Trademark and trade secret, Case Study.

Unit -V Geographical Indications and Trade Secrets 9

Overview of Geographical Indications, Importance of Geographical Indication Protection.Geographical Indication of Goods- Type, why and how GI need protection and GI Laws. Indian GI Act. Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigations.

TOTAL HOURS: 45

OUTCOMES:

1. Student will be able to define need and importance of intellectual property rights.
2. Rules and process for IPR registration.
3. Patent Searching, Patent Drafting, filing, Protection and duration of a patent in India and abroad.
4. Legal concepts in Science, Engineering, Technology and Creative Design.
5. Clarity on the influence of Geographical Indications on Trade Secrets.

REFERENCES:

1. Watal,Jayashree, Intellectual Property Rights In The WTO And Developing
2. Countries,Oxford University Press
3. R. Anita Rao & Bhanoji Rao, Intellectual Property Rights- A Primer, Eastern
4. Book Co.
5. Shiv Sahai Singh, The Law Of Intellectual Property Rights, Eastern Book Co.
6. Deepa Goeland Shomini Parashar, IPR, Biosafety and Bioethics, Pearson publisher
7. Pandey, Neeraj, Dharni, Khushdeep, Intellectual Property Rights, PHI, 2020.
8. Sople, Vinod V. Managing Intellectual Property: The Strategic Imperative, PHI, 2020.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1				1				
CO2	1							
CO3				1				
CO4		2						
CO5				1				
Avg.	1	2		1				

MBA103	INDUSTRIAL PSYCHOLOGY	L	T	P	C
		3	0	0	0

OBJECTIVES:

1. To understand the core concepts, history, and significance of Industrial Psychology
2. To analyze factors influencing employee attitudes, behaviors, and well-being.
3. To apply principles of ergonomics and human factors to improve workplace design and safety.
4. To evaluate different theories of motivation and their practical applications in organizational settings.
5. To assess team dynamics, cultural diversity, and organizational change processes in modern workplaces.

UNIT I: FOUNDATIONS OF INDUSTRIAL PSYCHOLOGY AND JOB ANALYSIS **9**

Definition, Characteristics, Goals, and Importance of Industrial Psychology - Brief History of Industrial Psychology - Major Fields in Industrial Psychology - Research Methods in Industrial Psychology - Job Analysis: Methods and Techniques - Performance Measurement: Concepts and Practices - Performance Rating and Evaluation - The Social Context of Performance Evaluation.

UNIT II: EMPLOYEE ATTITUDES, BEHAVIOUR, AND WELL-BEING **9**

Work Attitudes and Employee Engagement - Job Satisfaction and Organizational Commitment - Positive Employee Behaviors - Worker Stress: Sources, Consequences, and Coping Strategies.

UNIT III : ERGONOMICS AND ENGINEERING PSYCHOLOGY **9**

Principles of Ergonomics and Human Factors - Work Design for Productivity and

Well-being- Psychological Aspects of Workplace Safety - Human-Technology Interaction.

UNIT IV: MOTIVATION IN THE WORKPLACE 9

Defining and Theories of Motivation - Need-Based Theories of Motivation (e.g., Maslow's Hierarchy of Needs, Alderfer's ERG Theory) - Behaviour-Based Theories of Motivation (e.g., Skinner's Reinforcement Theory) - Job Design Theories of Motivation (e.g., Hackman and Oldham's Job Characteristics Model) - Motivation and Performance - Practical Techniques to Enhance Motivation

UNIT V: GROUP DYNAMICS AND ORGANIZATIONAL CULTURE 9

Defining Work Groups and Teams - Types of Teams and Team Processes - Group Decision- Making and Effectiveness - Diversity and Multiculturalism in Teams - Organizational Culture and Development - Social Dynamics and Change Management.

TOTAL HOURS: 45

COURSE OUTCOMES

1. Students will be able to understand Industrial Psychology by practicing Management theories in solving Industrial relations problems.
2. Students can apply critical thinking with regard to human attitudes and behavior for better decision making.
3. The managerial competencies among students can be enhanced by employing human factor with suitable ergonomics in workplace.
4. To inculcate value based leadership abilities amongst students in achieving individual as well as organizational goals.
5. Students can withhold cultural diversity in globalized business and engage in lifelong learning.

REFERENCES

1. Aamodt, M. G. (2016). Industrial/Organizational Psychology: An Applied Approach (6th Edition), Cengage Learning.

2. Landy, F. J., & Conte, J. M. (2016). Work in the 21st Century: An Introduction to Industrial and Organizational Psychology (4th Edition), Wiley.
3. Riggio, R. E. (2017). Introduction to Industrial and Organizational Psychology (6th Edition), Routledge.
4. Salvendy, G. (2006). Handbook of human factors and ergonomics (3rd ed.). New York: Wiley.
5. Levy, P. E. (2017). Industrial/Organizational Psychology: Understanding the Workplace (5th Edition), Macmillan Learning
6. Culbertson, S. S., & Muchinsky, P. M. (2022). Psychology Applied to Work (13th Edition), Hypergraphic Press.
7. Spector, P. E. (2017). Industrial and Organizational Psychology: Research and Practice (7th Edition), Wiley.
8. Truxillo, D. M., Bauer, T. N., & Erdogan, B. (2016). Psychology and Work: Perspectives on Industrial and Organizational Psychology (1st Edition), Routledge.

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3			1				1
CO2		3	2		1		1	
CO3	1					1		
CO4	2		2		1		1	
CO5				3				2
	2	3	2	2	1	1	1	2

MBA104	INDIAN CONSTITUTION	L	T	P	C
		3	0	0	0

OBJECTIVES:

1. To create an awareness on the constitution of India and its amendments.
2. To educate the students with fundamental duties and rights of the citizens.
3. To equip with the functions of central government and its' structure.
4. To learn the state government structure and its' functions.
5. To understand the judiciary structure and its functions in India.

UNIT I: INTRODUCTION **09**

Introduction to constitution of India – Philosophical Foundations and Historical Background – Preamble – Schedule – 42nd Amendment - 44th Amendment – 73rd Amendment - 74th Amendment – Articles Related to Amendments.

UNIT II: FUNDAMENTAL DUTIES AND RIGHTS OF CITIZENS **09**

Citizenship – Citizenship Amendment Act (CAA) – Union of States - Union Territories - Fundamental Rights – Directive Principles of State Policy (DPSP) – Fundamental Duties - Reference of Articles for Granting of Special Status to Various States in the Country.

UNIT III: CENTRAL GOVERNMENT STRUCTURE AND FUNCTIONS **09**

Government at Central Level – President of India – Powers of President of India – Structure of Central Government – Functions of Central Government – Vice President – Powers of Vice President – Powers of Prime Minister – Powers of Cabinet Ministers – Powers of Parliament.

UNIT IV: STATE GOVERNMENT STRUCTURE AND FUNCTIOONS **09**

Government at State Level – Structure of State Government – Functions of State Government – Governor – Powers of Governor – Chief Minister – Powers of Chief Minister – State Legislature – Powers of Cabinet Ministers in State Legislature – Cabinet Ministers Responsibilities in State Government.

UNIT V: JUDICIARY STRUCTURE AND FUNCTIONS **09**

Supreme Court of India – Judiciary System in Indian Constitution – Judicial

Systems Central Government Level – Judiciary System in State Government Level – High Courts and Subordinate Courts – Election Commission of India – Case Studies of Major Disputes.

TOTAL HOURS: 45

OUTCOMES:

1. Students will be able to understand the constitution of India and its' amendments.
2. Students will be able to analyze the fundamental duties and rights of citizens.
3. Students will be able to narrate the central government structure and its functions.
4. Students will be able to discuss the state government structure and its functions.
5. Students will be able to derive judiciary structure and its functions.

REFERENCES:

1. Basu, D. D. (1966). Introduction to the Constitution of India. LexisNexis, India.
2. Khosla, Madhav (2012). The Indian Constitution. Oxford University Press, India.
3. R.C.Agarwal (1997). Indian Political System. SChand Company Ltd., India.
4. Bakshi, P. (2023). The Constitution of India. LexisNexis, India.
5. V. N. Shukla (2017). Constitution of India, 13th Ed., Eastern Book Company.

PO-CO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2			1				1
CO2	2		3	2	3	3	1	1
CO3	2	3	2	1		1		
CO4	2		2	1		1		
CO5	2		2	1	2	1	1	
Avg.	2	3	1.8	1.2	2.5	1.5	1	1

MANDATORY COURSES – II

S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	MGE201	Well Being with traditional Practices -Yoga, Ayurveda and Siddha	MC	3	0	0	3	0
2.	MGE202	History of Science and Technology in India	MC	3	0	0	3	0
3.	MCY201	Awareness of Cyber Security and Cyber Law	MC	3	0	0	3	0
4.	MME201	Industrial Safety	MC	3	0	0	3	0

MGE201	WELL BEING WITH TRADITIONAL PRACTICES -YOGA, AYURVEDA AND SIDDHA	L T P C 3 0 0 0

OBJECTIVE

- To enjoy life happily with fun filled new style activities that help to maintain health
- To adopt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost-effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE 9

Health: Definition - Importance of maintaining health - More importance on prevention than treatment - Ten types of health one has to maintain - Physical health - Mental health - Social health – Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health – Environmental health. Occupational/Professional health. Present health status - The life expectancy- present status - mortality rate - dreadful diseases - Non- communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities. Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes – Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues. Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time. Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) – Maintaining BMI- Importance and actions to be taken.

UNIT II DIET 9

Role of diet in maintaining health - energy one needs to keep active throughout the day

– nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness - helps to reduce the risk of heart diseases - keeps the teeth and bones strong. Balanced Diet and its 7 Components - Carbohydrates – Proteins – Fats – Vitamins – Minerals - Fibre and Water.

Food additives and their merits & demerits - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions.

Definition of BMI and maintaining it with diet Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM Common cooking mistakes. Different cooking methods, merits and demerits of each method.

UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 9

AYUSH systems and their role in maintaining health - preventive aspect of AYUSH - AYUSH as a soft therapy. Secrets of traditional healthy living - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

Principles of Siddha & Ayurveda systems - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (TriDosha Theory) - Udal Thathukkal. Prevention of illness with our traditional system of medicine.

Primary Prevention - To decrease the number of new cases of a disorder or illness – Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention – To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS 9

Emotional health - Definition and types - Three key elements: the subjective experience

– the physiological response - the behavioural response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances – Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions. Stress management - Stress definition - Stress in daily life - How stress affects one's life -Identifying the cause of stress - Symptoms of stress - Managing stress (habits, tools, training, professional help) - Complications of stress mismanagement.

Sleep - Sleep and its importance for mental wellness - Sleep and digestion. Immunity - Types and importance - Ways to develop immunity.

UNIT V YOGA 9

Definition and importance of yoga - Types of yoga - How to Choose the Right Kind for Individuals according to the Age - The Eight Limbs of Yoga - Simple yoga asanas for cure and prevention of health disorders - What yoga can bring to our life.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completing the course, the students will be able to:

1. Learn the importance of different components of health
2. Gain confidence to lead a healthy life
3. Learn new techniques to prevent lifestyle health disorders
4. Understand the importance of diet and workouts in maintaining health
5. Understand the practice of yoga

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

MGE202 HISTORY OF SCIENCE AND TECHNOLOGY IN INDIA L T P C
3 0 0 0

COURSE OBJECTIVE:

- To know the contributions of the scientists for the development of society over a period of time.
- To understand the Science and Technological developments that lead to human welfare.
- To appreciate the Science and Technological contributions for the development of various sectors of the country.
- To identify the technical transfer versus economic progress of the countries.
- To know the students get a holistic view of the development of science and technology as a historical and cultural phenomenon.

UNIT I HISTORICAL PERSPECTIVE OF SCIENCE AND TECHNOLOGY 9

The nature of science and technology, Roots of science and technology in India, Science and society, Science and Technology-Meaning, Scope and Importance, Interaction of science, technology & society, Indian contribution to science and technology (from Ancient to Modern). Aryabhata, Charaka, Bhaskara II, Sushruta, J C Bose, C V Raman, Homi J Bhaba, Dr APJ Abdul kalam

UNIT II SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA 9

Scientific and Technological Developments in Medieval India; Influence of the Islamic world and Europe; The role of maktabs, madrasas and karkhanas set up. Developments in the fields of Mathematics, Chemistry, Astronomy and Medicine. Innovations in the field of agriculture - new crops introduced new techniques of irrigation etc.

UNIT III SCIENCE AND TECHNOLOGY IN COLONIAL INDIA 9

Early European Scientists in Colonial India- Surveyors, Botanists, Doctors, under the Company‘s Service- Indian Response to new Scientific Knowledge, Science and Technology in Modern India- Development of research organizations like CSIR and DRDO; Establishment of Atomic Energy Commission; Launching of the space satellites.

UNIT IV IMPACT OF SCIENCE AND TECHNOLOGY IN MAJOR AREAS 9

Space – Objectives of space programs, Geostationary Satellite Services – INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology

Ocean Development – Objectives of ocean development, Biological and mineral resources, Marine research and capacity building. Defence Research – Spin-off technologies for civilian use, Biotechnology – Applications of biotechnology in medicine, Biocatalysts, Agriculture, Food, Fuel and Fodder, Development of biosensors and animal husbandry

Energy – Research and development in conservation of energy, India's nuclear energy program, technology spin-offs.

UNIT V NEXUS BETWEEN TECHNOLOGY TRANSFER AND DEVELOPMENT 9

Transfer of Technology – Types, Methods, Mechanisms, Process, Channels and Techniques, Appropriate technology- Criteria and selection of Appropriate technology: Technology assessment, Technological forecasting, Technological innovations and barriers of technological change. Social implications of new technologies like the Information Technology and Biotechnology

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kalpana Rajaram, Science and Technology in India, Published and Distributed by Spectrum Books (P) Ltd., New Delhi – 58.

2. Srinivasan, M., Management of Science and Technology (Problems & Prospects), East-West Press (P) Ltd., New Delhi.

REFERENCE:

1. Ramasamy, K.A., and Seshagiri Rao, K., (Eds), Science, Technology and education for Developlemnt, K., Nayudamma Memorial Science Foundation, Chennai – 8.

2. Kohili, G.R., The Role and Impact of Science and Technology in the Development of India, Surjeet Publications.

3. Government of India, Five Year Plans, Planning Commission, New Delhi.
4. Sharma K.D., and Quresh M.A., Science, Technology and Development, Sterling Publications (P) Ltd., New Delhi.

ONLINE LINK
Swayam online course History of Science and Technology:
https://onlinecourses.swayam2.ac.in/arp19_ap87/preview

COURSE OUTCOME
At the end of the course students must obtain a sufficient level of knowledge about:

1. The origins of scientific knowledge, Names, major milestones in the life and work of prominent scientists and engineers.
2. Periodization of the history of science and technology.
3. Major events, dates of the most significant achievements in the development of science
4. and technology at different stages of history;
5. Features of the network of scientific and technical institutions, the history of formation and development of leading research centers, in particular higher education institutions as centers of basic and applied research.
6. Features of science and technology and it development

ASSESSMENT: QuizzesAssignment, Case Study / Presentation Continuous Assessment Test

MCY201 AWARENESS OF CYBER SECURITY AND CYBER LAW L T P C
3 0 0 3

COURSE OBJECTIVES

- To understand the basics of cyber security and cyber law,
- To understand the problems and issues associated with it,
- To understand the various act or regulations,
- To understand the various approaches for incident analysis and response.
- To understand the ethical laws of computer for different countries.

UNIT I INTRODUCTION TO CYBER SECURITY AND CYBER CRIME 9

Introduction–Cyber Crime: Definition and origins– Cyber crime and information Security– Cyber criminals– Classification of Cyber crimes.

UNIT II LEGAL PERSPECTIVES 9

Introduction to the Legal Perspectives of Cybercrimes and Cyber security, Cybercrime and theLegal Landscape around the World, Why Do We Need Cyber laws, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India.

UNIT II CYBER ACT 9

Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario.

UNIT IV CYBER LIABILITY 9

Private ordering solutions, Regulation and Jurisdiction for global Cyber security, Copy Right–source of risks, Pirates, Internet Infringement, Fair Use, postings, criminal liability, First Amendments, Data Losing.

UNIT V CYBER CHANGES 9

Ethics, Legal Developments, Cyber security in Society, Security in cyber lawscase studies, General law and Cyber Law–a Swift Analysis.

TOTAL: 45 PERIODS

Course Outcomes

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

CO1 - Understand key terms and concepts in cyber security and cyber law, intellectual property and cyber– crimes,trademarks and domain theft.

CO2 -. Determine computer technologies, digital evidence collection.

CO3 - Determine evidentiary reporting in forensicacquisition.

CO4 - Secure both clean and corrupted systems, protecting personal data,securing simple computer networks, and safe Internet usage.

CO5 – Incorporate approaches for incident analysis and response.

Text Books

1. Kennesaw State University, Big Data Security and Privacy Group (2020). *Cyber Security and Cyber Law: A Comprehensive Guide to Legal Aspects of Cyber Security*, 1st Edition, Wiley.
2. Sunit Belapure and Nina Godbole, Cyber Security: UnderstandingCyber Crimes, Computer Forensics and Legal Perspectives, WileyIndia Pvt. Ltd, 2011.
3. Jonathan Rosenoer, "Cyber Law: The law of the Internet", Springer–Verla..1997

Reference Books

1. Michael J. Kearns, Aaron K. B. P. (2022). *Cyber Security Law: A Practical Guide to Emerging Legal Issues*, 1st Edition, Oxford University Press
2. Dr. Farooq Ahmad, Cyber Law in India, Allahbad Law Agency– Faridabad.2012
3. Mark F Grady, Fransesco Parisi, "The Law andEconomics of Cyber Security", Cambridge University Press, 2006.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO 3	PO4	PO 5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
1	2											2	1			
2		2		2		2									2	2
3								2					1			
4		3	2					2				2			2	1
5	2					2								2		
avg	2	2.5	2	2		2		2				2	1	2	2	1.5

MME201	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To discuss the basic approaches of the organizations and safety management
2. To discuss the concept of Work design and facility planning
3. To comprehend the accident investigation process and accident reports
4. To discuss the principles of safety performance monitoring
5. To elaborate the methods of safety education and training

UNIT I BASICS OF SAFETY ENGINEERING & ACTS 9

Evolution of modern safety concept – Safety audit – Acts: Factories act – 1948 – Statutory authorities – Tamil Nadu factories Rules 1950 under safety and health – Environment act – 1986 –Air act 1981, Water act 1974 – other acts; Safety in industries – General safety concepts, machine guarding, hazards in metal removing process, welding process, cold and hot working process. Introduction to Electrical Acts.

UNIT II SAFETY MANAGEMENT 9

History of Safety movement –Evolution of modern safety concept General concepts of management – Planning for safety for optimization of productivity, quality and safety line and staff functions for safety, budgeting for safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT III ACCIDENT INVESTIGATION AND REPORTING 9

Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – Principles of accident prevention, Supervisory role - Role of safety committee – Accident causation models Cost of accident. Overall accident investigation process Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, Functions of investigator, Four types of evidences, Records of accidents, Accident reports Class exercise with case study.

UNIT IV SAFETY PERFORMANCE MONITORING 9

Reactive and proactive monitoring techniques, Permanent total disabilities, Permanent partial disabilities, Temporary total disabilities - Calculation of accident indices, Frequency rate, Severity rate, Frequency severity incidence, Incident rate, Accident rate, Safety “t” score, Safety.activity rate problems.

UNIT V SAFETY EDUCATION AND TRAINING 9

Importance of training identification of training needs training methods – programme, seminars, conferences, competitions – method of promoting safe practice motivation – communication role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Learn the basic approaches of the organizations and safety management
2. Perform work design and facility planning
3. Study the accident investigation process and accident reports
4. Learn the principles of safety performance monitoring
5. Study the methods of safety education and training

TEXTBOOKS:

1. L M Deshmukh, Industrial safety management, TATA McGraw Hill, 2017.
2. Heinrich H.W., Industrial Accident Prevention, McGraw Hill Company, New York, 2001.

REFERENCES:

1. Garg, HP, Maintenance Engineering, S. Chand Publishing, 2012
2. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

MME204	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		1			2			1			2	1	
CO2		1		2				2			1		1	
CO3	2			2			1			2		2	1	
CO4	2		3			2			2		1		1	
CO5		2			2			1				1	1	
Average	3	1	1	1	1	1		1	1	1	1	1	1	

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: BIO ENGINEERING

VERTICAL 1: BIO ENGINEERING								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PMD101	Biomaterials	PEC	3	0	0	3	3
2.	PMD102	Artificial Organs and Implants	PEC	3	0	0	3	3
3.	PMD103	Biomedical Optics and Photonics	PEC	3	0	0	3	3
4.	PMD104	Neural Engineering	PEC	3	0	0	3	3
5.	PMD105	Tissue Engineering	PEC	3	0	0	3	3
6.	PMD106	Genetic Engineering	PEC	3	0	0	3	3

PMD101	BIOMATERIALS	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 study about soft tissue replacement and hard tissue replacement.
- To highlight the importance of bionanomaterials and their practical uses to the students.

UNIT – I: INTRODUCTION **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, bioresorbable, bioactive ceramics and 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: TISSUE REPLACEMENT IMPLANTS **9**

Small intestinal sub mucosa and other decullarized matrix biomaterials for tissue repair: Extra cellular Matrix. Softtissue replacements, sutures, surgical tapes, adhesive, Percutaneous and skin implants, maxillofacial augmentation, Vascular grafts, hard tissue replacement Implants, joint replacements, tissue scaffolding and engineering using Nano biomaterials.

UNIT – V: APPLICATIONS OF NANO BIOMATERIALS 9

Applications of nanoantibiotics-Nanomedicines- Biochips – Biomimetics- BioNEMs -Biosensor-Bioimaging/Molecular Imaging- challenges and future perspective.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

CO1: Analyze different types of Biomaterials and its classification.

CO2: Identify different metals, ceramics and its nanomaterial characteristics as biomaterials.

CO3: Perform combinations of materials that could be used as a biopolymer materials for implant.

CO4: Interpret the different types of soft tissue replacement and hard tissue replacement.

CO5: Acquires understanding of the significance of nanobiomaterials in the field of Biomedical applications.

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.

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**
CO1	-	3	3	3	-	3	-	-	-	-	-	3	2	2
CO2	3	3	3	-	-	-	2	-	-	-	-	-	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
Avg	**3**	**3**	**3**	**3**	**-**	**3**	**2**	**2**	**-**	**3**	**-**	**3**	**2**	**2**

PMD102 ARTIFICIAL ORGANS AND IMPLANTS L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To have a comprehensive understanding of artificial organs and transplants.
- To outline the fundamental concepts of implant design using a case study.
- To investigate and learn about the basics of artificial organs.
- To acquire knowledge of various types of artificial organs.
- To study about various implantable medical devices.

UNIT –I INTRODUCTION 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 – II: PRINCIPLES OF IMPLANT DESIGN 9

Principles of implant design, Clinical problems requiring implants for solution, Permanent versus absorbable devices, the missing organ and its replacement, Tissue engineering, scaffolds, cells and regulators criteria for materials selection, Case study of organ regeneration.

UNIT – III: BASICS OF ARTIFICIAL ORGAN 9

Introduction -artificial organ, Artificial Pancreas - Skin and Hair organ - Artificial ear - Artificial Nose - Regeneration and Potential Future Uses for Stem Cells - Ethical consideration.

UNIT – IV: TYPES OF ARTIFICIAL ORGANS 9

Introduction to Biomaterials in Ophthalmology - Anatomy of eye - Viscoelastic solution - Contact lenses - Optical implants - Scleral buckling materials for retinal detachment - Artificial exchange systems: Blood viscosity Effects of shear on blood cells - Blood–air interactions - Blood flow in artificial devices – Exchangers – Hemodialysis - Soft Tissue Applications - Bulk space fillers -Maxillofacial implants.

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:

CO1: Acquire sufficient knowledge about artificial organs and transplantation.

CO2: Obtain a comprehensive understanding of implant design principles, including its characteristics and potential solutions.

CO3: Impart knowledge in basics of artificial organs.

CO4: Examine the compatibility and functionality of synthetic organs within a biological organism.

CO5: Analyze the various classifications 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.

4. Larry L. Hench and Julian R. Jones, Biomaterials, artificial organs and tissue engineering, CRC Press 2010.

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.

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
CO1	-	3	3	3	-	3	-	-	-	-	-	3	2	2
CO2	3	3	3	-	-	-	2	-	-	-	-	-	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
Avg	3	3	3	3	-	3	2	2	-	3	-	3	2	2

PMD103 BIOMEDICAL OPTICS AND PHOTONICS L T P C

3 0 0 3

OBJECTIVES:

- To acquire knowledge about the physical properties of light and optical properties of tissues.
- To learn the design and working principle of various optical instrumentation.
- To familiarize the principles and applications of optical biosensors.
- To study about the engineering and practical applications of lasers related to diagnostic and surgical applications.
- To explore the interaction mechanisms between lasers and biological tissues.

UNIT – I: OPTICAL PROPERTIES 9

Basic principles of light - Reflection - Refraction - Absorption - Polarization - Interference - Coherence, Basic laws of light - Beer Lambert law - Snell's law, Optical properties of tissues - Absorption - Scattering - Anisotropy.

UNIT – II: OPTICAL INSTRUMENTATION 9

Working principle of light sources - Lasers - LEDs, Working principle of optical detectors - Photodiode - Spectrometer - CMOS and CCD cameras - Lens - Optical filters - Optical fibers.

UNIT – III: OPTICAL BIOSENSORS 9

Principles of Optical biosensing - Immobilization of bio-recognition elements, Types of optical biosensor - Fiber optic - Planar waveguide - Evanescent - Interferometric - Surface plasmon resonance - Advantages and disadvantages - Applications.

UNIT – IV: APPLICATIONS OF LASERS 9

Diagnostic - Optical coherence tomography, Fluorescence, Raman, Photoacoustic tomography, Laser induced breakdown spectroscopy (LIBS), Hyperspectral imaging. Surgical - Lasers in dentistry, Dermatology, Ophthalmology.

UNIT – V: LASER TISSUE INTERACTION **9**

Laser tissue interactions via photochemical, Photothermal, Photomechanical techniques, Photodynamic therapy (PDT) - Oncological and non-oncological applications, Low level laser therapy (LLLT) - Biostimulation applications.

TOTAL PERIODS: 45

COURSE OUTCOMES:

CO1: Analyze and predict the optical behavior of tissues based on their physical properties.

CO2: Interpret the working principles of optical instrumentation.

CO3: Illustrate the working principles and applications of optical biosensors.

CO4: Examine the diagnostic and surgical applications of lasers in medicine.

CO5: Design and optimize the mechanisms and biological effects of laser-tissue interactions.

TEXT BOOKS:

1. Tuan Vo Dinh, “Biomedical Photonics –Handbook, CRC Press, Bocaraton, 2014.
2. Jurgen Popp, Valery V. Tuchin, Arthur Chiou and Stefen Heinemann, Handbook of Biophotonics, Vol 2: Photonics for Healthcare, John Wiley and Sons, 1st Edition, 2011.

REFERENCE BOOKS:

1. Markolf H. Niemz, “Laser-Tissue Interaction Fundamentals and Applications” Springer, 2007.
2. Splinter R and Hooper B. A., “An Introduction to Biomedical Optics”, Taylor and Francis, 2006.
3. Mark E. Brezinski, “Optical Coherence Tomography: Principle and Applications”, Academic Press, 2006.
4. Paras N. Prasad, “Introduction to Biophotonics”, A. John Wiley and sons, Inc.

Publications, 2003.

ONLINE RESOURCES

https://nptel.ac.in/courses/127/105/127105225/

https://onlinecourses.nptel.ac.in/noc21_ge13/preview

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
CO1	3	2	3	1	-	-	-	-	-	-	-	1	2	1
CO2	3	2	3	1	-	-	-	-	-	-	-	1	2	1
CO3	3	2	3	1	-	-	-	-	-	-	-	1	2	1
CO4	3	2	3	1	-	-	-	-	-	-	-	1	2	1
CO5	3	2	3	1	-	-	-	-	-	-	-	1	2	1
Avg.	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	-	**1**	**2**	**1**

PMD104	NEURAL ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:

- To be familiar with the neuron structure and functions.
- To explore the anatomy and functional areas of the brain, brain stem, and spinal cord.
- To impart knowledge in neural diseases and disorders.
- To understand the principles of neurophysiology and neuroradiology.
- To gain knowledge about the nerve reconstruction and rehabilitation.

UNIT – I: BASICS OF NEURON STRUCTURE AND FUNCTIONS 9

Nervous system development. Trophic factors, extra cellular matrix components in nervous system development. Neuron: structure – function – classification. Glial cells – myelination. Neurotransmitter – types and functions. Synapses - Transport of materials and impulse in neurons.

UNIT – II: BRAIN, BRAIN STEM AND SPINAL CORD 9

Brain: structures – lobes – functional areas. Brain stem: structures – functional areas. Spinal cord: structure – functions. Concepts of nuclei – sensory and motor Tracts - Reticular formation. Blood supply to Brain and spinal cord.

UNIT – III: NEURONAL DISEASES AND DISORDERS 9

Neuro degeneration: Degenerative, Demyelinated and injury related disorders associated with nervous system. Wallerian Degeneration. Neuronal plasticity – CNS acting drugs and their pharmacokinetics. Alzheimer‘s, Parkinson‘s and Prion diseases.

UNIT – IV: NEUROPHYSIOLOGY & NEURORADIOLOGY 9

Physiology of nerve conduction. Peripheral nerves – structure & Functions. Synaptic transmission and cellular signaling of Neurons. Electrical activity of the Brain and recording of brain waves. Evoked potentials. Visualization of nervous system

Neuromotor-machine interface: human voluntary motor control system.

UNIT – V: NERVE RECONSTRUCTION AND REHABILITATION 9

Neural plasticity; Neurological dysfunctions - Regeneration of the peripheral nervous system. Neural tissue engineering; Nerve graft; Drug delivery system in CNS. Rehabilitation: Mechanisms for Neuromotor rehabilitation; Robotics and virtual reality in physical therapy; Transcranial magnetic stimulation.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Enumerate the basic structure and functions of human nervous system.

CO2: Examine the structures and functions of the brain, brain stem and spinal cord.

CO3: Analyze the neural diseases and injury-related disorders affecting the nervous system.

CO4: Understand the techniques used in neurophysiology and neuroradiology.

CO5: Illustrate the mechanisms involved in the regeneration of the peripheral nervous system and neuromotor rehabilitation.

TEXT BOOKS:

1. Mathews G.G., “Neurobiology”, 2nd edition, Blackwell Science, UK, 2000.
2. Malcom Carpenter, “Textbooks of Neuroanatomy”, Mc. Graw hill Edition, 1996.

REFERENCE BOOKS

1. W. Mark Saltzman, “Tissue Engineering – Engineering principles for design of replacement organs and tissue’’, Oxford University Press Inc New York, 2004.
2. Park J.B., “ACS Biomaterials Science and Engineering”, Plenum Press, 2014. Saunders, 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
CO1	3	2	1	1	2	-	-	-	-	-	-	-	2	1
CO2	3	2	1	1	2	-	-	-	-	-	-	-	2	1
CO3	3	2	1	1	2	-	-	-	-	-	-	-	2	1
CO4	3	2	1	1	2	-	-	-	-	-	-	-	2	1
CO5	3	2	1	1	2	-	-	-	-	-	-	-	2	1
Avg.	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**

PMD105	TISSUE ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:

- To introduce students to the fundamental concepts of cell biology.
- To gain the basic knowledge about fundamentals of tissue engineering.
- To define stem cells and explore different types of stem cells.
- To be familiar with the engineering methods used in tissue engineering.
- To explore the application of tissue engineering in replacement and regenerative engineering.

UNIT – I: INTRODUCTION TO CELL BIOLOGY 9

Cell types - Progenitor cells - Cell growth and differentiation - Cell culture: Expansion- Transfer - Storage and Characterization - Cell signalling molecules - Growth factors- Cell attachment: Differential cell adhesion, Receptor-ligand binding - Cell surface markers.

UNIT – II: FUNDAMENTALS OF TISSUE ENGINEERING 9

History and scope of tissue engineering - Tissue organization - Tissue types: Epithelial, Connective - Vascularity and angiogenesis - Wound healing - Extra Cellular Matrix: Matrix molecules and their ligands - Tissue culture – Materials in tissue engineering.

UNIT – III: STEM CELLS 9

Definition of stem cells – Types of stem cells – Differentiation, dedifferentiation maturation, proliferation, pleuripotency and immortalization - Sources of stem cells: Haematopoetic – Fetal - cord blood – Placenta - Bone marrow - Primordial germ cells - Cancer stem cells - Induced pleuripotent stem cells.

UNIT – IV: ENGINEERING METHODS AND DESIGN **9**

Soft lithography - Self-assembled monolayer, Micro contact printing, Micro fluidic patterning - Laminar flow patterning - Cell interaction with Polymer scaffolds and gels- Polymer scaffolds fabrications: Electro spinning - Solvent casting and particulate leaching - Micro fabrication of cell seeded scaffolds.

UNIT – V: APPLICATIONS OF TISSUE ENGINEERING **9**

Replacement Engineering: Bone, cartilage, skin, blood, pancreas, kidney, heart valve and liver - Regenerative engineering: Peripheral Nerve regeneration, Cardiac tissue regeneration, Muscle regeneration – Regulation, Commercialization and Patenting.

TOTAL PERIODS: 45

COURSE OUTCOMES:

CO1: Examine the basic concepts of cell biology.

CO2: Evaluate the scope of tissue engineering.

CO3: Classify stem cells based on their characteristics and sources.

CO4: Apply various engineering methods and design.

CO5: Analyze the specific application of tissue engineering.

TEXT BOOKS:

1. Robert P Ianza, Robert Langer, Joseph Vacanti, "Principles of Tissue Engineering", Academic Press, United States, 2020.
2. Donglu Shi, Qing Liu, “Tissue Engineering and Nanotheranostics”, World Scientific Publications, Singapore, 2018.

REFERENCE BOOKS:

1. Gary E. Wnek, Gary L Browlin, “Encyclopedia of Biomaterials and Biomedical Engineering”, Marcel Dekker Inc, New York, 2008.
2. R. Lanza, Anthony Atala (Eds), “Essential of Stem Cell Biology”, Academic Press, USA, 2013.

3. R. Lanza, Anthony Atala,"Handbook of Stem Cells'', Academic Press, USA, 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**
CO1	3	2	3	1	-	-	-	-	-	-	-	1	1	2
CO2	3	2	3	1	-	-	-	-	-	-	-	1	1	2
CO3	3	2	3	1	-	-	-	1	1	-	-	1	1	2
CO4	3	2	3	1	-	-	-	1	2	-	-	1	1	2
CO5	3	2	3	1	-	-	-	-	-	-	-	1	1	2
AVg.	**3**	**2**	**3**	**1**	**-**	**-**	**-**	**1**	**2**	**-**	**-**	**1**	**1**	**2**

PMD106	GENETIC ENGINEERING	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made:

- To learn the basics of Mendelian principle in genetic engineering.
- To understand the structure, function and role of chromosomes.
- To acquire knowledge about the basics of recombinant DNA technology.
- To highlight the importance of DNA libraries.
- To enhance knowledge in DNA sequencing and amplification.

UNIT – I: MENDELIAN PRINCIPLE 9

DNA as hereditary material, Mendel and his experiments, laws of inheritance, variations in Mendel‘s Theme: incomplete dominance, co-dominance and multiple allele, Gene interactions; Epistasis, Duplicate, Complementary, Supplementary and Lethal genes

UNIT – I: CHROMOSOMES 9

Structural organization, variation in the number and structure of chromosome; Haploids, missing and extra chromosome (Euploid and aneuploid); Deletion, Duplication, Translocation and other structural rearrangements. Chromosomal studies - karyotyping. Chromosomal theory of inheritance; clues from inheritance of sex, linkage, crossing over.

UNIT – III: RECOMBINANT DNA TECHNOLOGY 9

Manipulation of DNA – Restriction and Modification enzymes - Design of linkers and adaptors - Characteristics of cloning and expression vectors - Introduction of recombinant DNA in to host cells and selection methods.

UNIT – IV: DNA LIBRARIES 9

Construction of genomic and cDNA libraries, Artificial chromosomes – Bacteria, Yeast - Chromosomal walking.

UNIT – V SEQUENCING AND AMPLIFICATION OF DNA 9

Maxam Gilbert's and Sanger's methods of DNA sequencing – PCR: Inverse PCR, Nested PCR, Allele specific PCR, Hot start PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis.

TOTAL PERIODS: 45

COURSE OUTCOMES:

The student should be able to:

CO1: Explain the understanding of DNA and the fundamental concepts of inheritance.

CO2: Illustrate a well-founded knowledge about chromosomes

CO3: Impart knowledge to replicate genes with significant commercial value.

CO4: Understand the need of DNA libraries.

CO5: Gain knowledge and understanding of gene and genome sequencing methodologies

TEXT BOOKS:

1. David Friefelder, Molecular Genetics, Narosa publishing house, India, 2006.
2. Kavita B Ahluwalia, Genetics, New age international publishers, India. 2008.
3. Old RW, Primrose SB, "Principles of Gene Manipulation, An Introduction to Genetic Engineering", Blackwell Science Publications, 1993.
4. Principles of Genome Analysis and Genomics by S.B.Primrose and R.M.Twyman, 3rd Ed. (Blackwell Publishing).

REFERENCE BOOKS:

1. Isil Aksan Kurnaz, "Techniques in Genetic Engineering", CRC Press, 2015.
2. Gardner, E.J, Simmons, Snustad, Principles of Genetics, 8th Edition John Wiby & Sons ltd, 1991.
3. Griffith, Fundamentals of Genetics analysis, 7th Edition, W.H. Freeman & Company, Newyork, 2000.

4. Oksana Ableitner, “Introduction to Molecular Biology: Working with DNA and RNA (essentials)”, Springer International, 2022.R S Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill,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
CO1	-	-	-	-	-	-	-	2	-	-	-	3	2	2
CO2	3	-	-	-	-	-	-	2	-	-	-	-	2	2
CO3	3	-	-	-	-	3	-	3	-	-	-	3	2	2
CO4	3	3	-	-	-	3	2	3	-	3	-	-	2	2
CO5	3	3	3	2	-	3	2	3	-	-	-	3	2	2
Avg	**3**	**3**	**3**	**2**	**-**	**3**	**2**	**3**	**-**	**3**	**-**	**3**	**2**	**2**

VERTICAL 2: MEDICAL DEVICE INNOVATION AND DEVELOPMENT								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PME207	Foundation Skills in integrated Product Development	PEC	3	0	0	3	3
2.	PMD201	Medical Device Design	PEC	3	0	0	3	3
3.	PMD202	Patient safety, Standards and Ethics	PEC	3	0	0	3	3
4.	PMD203	Hospital Waste Management	PEC	3	0	0	3	3
5.	PMD204	Medical Innovation and Entrepreneurship	PEC	3	0	0	3	3
6.	PME208	Rapid Prototyping	PEC	3	0	0	3	3

PME207	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L T P C 3 0 0 3

OBJECTIVES:

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

UNIT I BASICS OF PRODUCT DEVELOPMENT 9

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

UNIT II REQUIREMENTS AND SYSTEM DESIGN 9

Requirement Engineering - Types of Requirements - Requirement Engineering - traceability Matrix and Analysis - Requirement Management - System Design & Modeling - Introduction to System Modeling - System Optimization - System Specification - Sub-System Design - Interface Design.

UNIT III DESIGN AND TESTING 9

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

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

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

UNIT V BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY 9

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

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1: Define, formulate, and analyze a problem.

CO2: Solve specific problems independently or as part of a team.

CO3: Gain knowledge of the Innovation & Product Development process in the Business Context.

CO4: Work independently as well as in teams.

CO5: Manage a project from start to finish.

TEXT BOOKS:

1. Karl T Ulrich and Stephen D Eppinger, "Product Design and Development", Tata McGraw Hill, Fifth Edition, 2011.
2. John W Newstorm and Keith Davis, "Organizational Behavior", Tata McGraw Hill, Eleventh Edition,2005.

REFERENCES:

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

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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

(1-LOW, 2-MEDIUM, 3-HIGH)

PMD201 **MEDICAL DEVICE DESIGN** **L T P C**

3 0 0 3

OBJECTIVES:

- To identify problems and develop concepts.
- To introduce the Medical device standards and requirements.
- To illustrate the design procedure of medical devices and its metrics.
- To comprehend the validation and verification of various medical devices.
- To explore software and hardware manufacturing of medical devices.

UNIT - I: PROTOTYPE MODELLING AND CONCEPT GENERATION 9

Strategic Focus – observation and problem identification – Need statement development. Ideation and Brainstorming – concept screening, concept selection: intellectual property basics – reimbursement basics – business models – prototyping.

UNIT - II MEDICAL DEVICES STANDARDS AND REQUIREMENTS 9

FDA, Medical devices classification, Medical Devices Directive Process – Harmonized Standards, ISO13485, ISO 14971, IEC60601-1, IEC 62304. Reliability, Concept of failure, Product Design and Development Process.

UNIT - III DESIGN ENGINEERING 9

Hardware Design, Hardware Risk Analysis, Design and Project Metrics, Design for Six Sigma, Software Design, Software Coding, Software Risk Analysis, Software Metrics.

UNIT - IV: TESTING AND VALIDATION 9

Basis and Types of Testing, Hardware Verification and Data Analysis, Software Verification and Data Analysis.

UNIT - V: DESIGN TRANSFER AND MANUFACTURING 9

Transfer to Manufacturing, Hardware Manufacturing, Software Manufacturing, Configuration Management, Intellectual Property-Copy Rights-Trademarks-Trade Secrets. Case Study.

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

CO1: Summarize the concept of medical device development.

CO2: Define the medical devices standards and requirements.

CO3: Explore the engineering design and project metrics.

CO4: Examine the testing and validation of medical equipment.

CO5: Interpret the various design transfer and manufacturing methods.

TEXT BOOKS:

1. Zenios, Makower and Yock, —Biodesign – The process of innovating medical technologies‖, Canbridge University Press, 2009.
2. Theodore R. Kucklick The Medical Device R&D Handbook, Second Edition, CRC Press, 2012.
3. Peter Ogrodnik,Medical Device Design Innovation from Concept to Market, Elsevier, 2013.

REFERENCE BOOKS:

1. Richard C. Fries and Marcel Dekker AG, Handbook of Medical Device Design, 2nd Edition, 2005.
2. Gail Baura, Medical Device Technologies: A Systems Based Overview using Engineering, Elsevier science, 2012.
3. Matthew Bret Weinger, Michael E. Wiklund, Daryle Gardner- Bonneau‘ Handbook of Human Factors in Medical Device Design‘,CRC press,2010.
4. Jagdish Chaturvedi, Inventing medical devices: A perspective from India, CreateS
5. pace Independent Publishing Platform, 1st 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
CO1	3	2	1	1	1	-	-	-	-	1	-	1	2	-
CO2	3	2	1	1	1	-	-	-	-	1	-	1	2	3
CO3	3	2	1	1	1	-	-	1	1	1	-	1	2	3
CO4	3	2	1	1	1	-	-	1	1	1	-	1	2	3
CO5	3	2	1	1	1	-	-	1	1	1	-	1	2	-
Average	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**1**	**1**	**1**	**-**	**1**	**2**	**3**

PMD202	PATIENT SAFETY, STANDARDS AND ETHICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- To gain insight into patient safety against electrical hazards.
- To explain the patient safety laws and regulations.
- To examine the standards and testing of patient.
- To analyze the various patient safety specialties in clinical practice.
- To familiarize about the ethics and health care organization.

UNIT – I: HAZARDS 9

Physiological effects of electricity - important susceptibility parameters - microshock - macroshock hazards -patients electrical environment - isolated power system - conductive surfaces.

UNIT – II: PATIENT SAFETY LAWS AND REGULATIONS 9

Mandatory Reporting systems. Anatomy of a patient safety Law: Compliance Tips, Federal patient safety Legislation Initiatives, Medical Device Reporting, Clinical trials and Adverse- Event 116 Reporting, Patient safety Goals and standards, The Quality Assessment and performance Improvement rule.

UNIT – III: STANDARDS AND TESTING 9

Guidelines and safety practices to improve patient safety, Electrical safety codes and standards - IEC 60601-1 2005 standard, Basic Approaches to protection against shock, protection equipment design, Electrical safety analyser - Testing the electric system

UNIT – IV: PATIENT SAFETY IN MAIN CLINICAL SPECIALITIES 9

Intensive care and Anesthesiology, safety surgery save lives, Emergency department clinical risk, Obstetric safety patient, Patient safety in internal medicine, Patient safety in Radiology.

UNIT – V: MEDICAL ETHICS **9**

Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics- Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor and Society, Case Studies.

TOTAL PERIODS:45

COURSE OUTCOMES:

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

CO1: Outline the importance of patient safety against electrical hazards.

CO2: Brief out the patient safety laws and regulations.

CO3: Explain the standards and testing of patient.

CO4: Comprehend the concept of the patient safety specialities in clinical systems.

CO5: Explore the ethics in various health care organization.

TEXT BOOKS:

1. Liam Donaldson, Walter Ricciardi, “Textbook of patient safety and clinical Risk management”, Springer.
2. Fay A. Rozovsky, James R. Woods, Jr, “The Handbook of Patient Safety Compliance”, 2016.

REFERENCE BOOKS:

1. John G.Webster, “Medical Instrumentation Application and design”, 4th edition, Wiley India PvtLtd, New Delhi, 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
CO1	3	2	1	1	1	-	-	2	-	1	-	1	1	3
CO2	3	2	1	1	1	-	-	2	-	1	-	1	1	3
CO3	3	2	1	1	1	-	-	2	-	1	-	1	1	3
CO4	3	2	1	1	1	-	-	2	-	1	-	1	1	3
CO5	3	2	1	1	1	-	-	2	-	1	-	1	1	3
Avg	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**2**	**-**	**1**	**-**	**1**	**1**	**3**

PMD203	HOSPITAL WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

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

UNIT – I: 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 – II: HAZARD CONTROL **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 – III: 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 – 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: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Familiarize the concepts of healthcare, waste management and hazard control.

CO2: Gain insights in the treatment of biomedical waste and its management.

CO3: Apply principles of safety in handling hazardous materials.

CO4: Plan and implement facility safety process and procedures.

CO5: Gain knowledge 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
CO 1	1	2	2	2	-	3	2	-	-	-	-	-	1	-
CO 2	2	1	1	1	-	2	2	-	-	-	-	-	1	-
CO 3	1	2	2	2	-	2	2	-	-	-	-	-	1	-
CO 4	2	1	1	1	-	2	3	-	-	-	-	-	1	-
CO 5	1	2	2	2	-	3	2	-	-	-	-	-	1	-
Avg.	1	2	2	2	-	3	2	-	-	-	-	-	1	-

PMD204 MEDICAL INNOVATION AND ENTREPRENEURSHIP L T P C

3 0 0 3

OBJECTIVES:

- To develop an understanding of the basics of creativity, innovation, and intellectual property rights.
- To comprehend the role of biomedical engineers in entrepreneurship.
- To apply the methods of entrepreneurship in medical field.
- To explore financing new ventures and marketing.
- To evaluate the medical devices and market trends

UNIT - I: CREATIVITY, INNOVATION AND IPR 9

The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges.

UNIT - II: SCOPE FOR ENTREPRENEURSHIP 9

Definition– Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs. Fundamentals and models, Advancements in biomedical field, Supporting societies and professional activities. Impact of innovation in medical devices. Case study.

UNIT - III: NEW VENTURE 9

Developing an Effective Business Model: The Importance of a Business Model – Starting a small-scale industry - Components of an Effective Business Model. Assessing the venture, establish venture invention, market research, presenting the business plan. Forms of Business Organization: Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. Case study.

UNIT - IV: FINANCING THE NEW VENTURE AND GLOBALIZATION 9

Evaluating various options and future investments – Medical Device entrepreneurship incentives and subsidies – Determining Financial Needs – Sources of Financing: support for product development, funding agencies,

collaborative initiatives, and angel investors. Impact of Globalization: Medical product manufacturing, marketing, leadership, quality management. Case studies.

UNIT-V: MARKETING FUNCTION 9

Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. Case study.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Describe ideas and creativity in entrepreneurship.

CO2: Interpret the background for biomedical engineers in entrepreneurship.

CO3: Acquire the skills and techniques required towards innovation.

CO4: Categorize the resources and funding agencies and judge the right product based on market needs.

CO5: Compile and quantify the opportunities and challenges.

TEXT BOOKS:

1. Jen-Shih Lee “Biomedical Engineering Entrepreneurship”, World Scientific Publishing, USA. 2010
2. Vasant Desai, —The Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, 2010.

REFERENCE BOOKS:

1. Brant Cooper, Patrick Vlaskovits, “The Lean Entrepreneur”, Wiley, 2nd edition, New Jersy, 2016.
2. Nathan Furr, Jeff Dyer, “The Innovator's Method: Bringing the Lean Start-up into Your Organization”, Harvard Business Press, Boston, 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
CO 1	3	2	1	1	1	1	1	3	-	1	-	1	1	-
CO 2	3	2	1	1	1	1	1	2	-	1	-	1	1	-
CO 3	3	2	1	1	1	1	1	2	-	1	-	1	1	-
CO 4	3	2	1	1	1	1	1	2	-	1	-	1	1	-
CO 5	3	2	1	1	1	1	1	2	-	1	-	1	1	-
Avg.	**3**	2	1	1	1	1	1	2	-	**1**	-	**1**	**1**	**-**

PME208 **RAPID PROTOTYPING** **L T P C**

3 0 0 3

OBJECTIVES:

The course aims to

- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices

UNIT I UI/UX **9**

Fundamental concepts in UI & UX - Tools - Fundamentals of design principles - Psychology and Human Factors for User Interface Design - Layout and composition for Web, Mobile and Devices - Typography - Information architecture - Color theory - Design process flow, wireframes, best practices in the industry - User engagement ethics - Design alternatives

UNIT II APP DEVELOPMENT **9**

SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup- Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

UNIT III INDUSTRIAL DESIGN **9**

Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning & Tolerancing

UNIT IV MECHANICAL RAPID PROTOTYPING **9**

Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in

different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing.

UNIT V ELECTRONIC RAPID PROTOTYPING 9

Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

CO1: Create quick UI/UX prototypes for customer needs

CO2: Develop web application to test product traction / product feature

CO3: Develop 3D models for prototyping various product ideas

CO4: Built prototypes using Tools and Techniques in a quick iterative methodology

CO5: Design the electronic circuits and fabrication of electronic devices

TEXT BOOKS

1. Peter Fiell, Charlotte Fiell, Industrial Design A-Z, TASCHEN America Llc(2003)

2. Samar Malik, Autodesk Fusion 360 - The Master Guide.

3. Steve Krug, Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability,Pearson,3rd edition(2014)

REFERENCES

1. https://www.adobe.com/products/xd/learn/get-star__ted.html

2. https://developer.android.com/guide

3. https://help.autodesk.com/view/fusion360/ENU/courses/

4. https://help.prusa3d.com/en/categor_y/prusaslicer_204

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

ME206	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	2	1	-	-	-	-	-	1	3	3	2
CO2	3	2	3	2	1	-	-	-	-	-	1	3	3	2
CO3	3	2	3	2	1	-	-	-	-	-	1	3	3	2
CO4	3	2	3	2	1	-	-	-	-	-	1	3	3	2
CO5	3	2	3	2	1	-	-	-	-	-	1	3	3	2
Average	3	2	3	2	1	-	-	-	-	-	1	3	3	2

(1-LOW, 2-MEDIUM, 3-HIGH)

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 3: MECHANICS								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PMD301	Biomechanics	PEC	3	0	0	3	3
2.	PMD302	Physiological Modeling	PEC	3	0	0	3	3
3.	PMD303	Rehabilitation Engineering	PEC	3	0	0	3	3
4.	PMD304	Assistive Technology	PEC	3	0	0	3	3
5.	PMD305	Ergonomics	PEC	3	0	0	3	3
6.	PMD306	Haptics	PEC	3	0	0	3	3

PMD301	BIOMECHANICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The student should be made to:

- Learn the fundamental concepts of the principles of mechanics.
- Familiarize the basics of bio fluid mechanics.
- Review the mechanical properties of musculoskeletal elements
- Acquire knowledge about the biomechanics of joints and implants.
- Explore the application of biomechanics into modelling and ergonomic design.

UNIT – I: INTRODUCTION TO MECHANICS 9

Introduction – Scalars and vectors, Statics –Resolution and composition of forces, Moments, couple, Resultant, equilibrium of coplanar forces, Dynamics – Linear motion, Newton's laws of motion, Velocity and acceleration, Kinematics – Models, Transducers Constitutive equations –Nonviscous fluid, Newtonian Viscous fluid and Hookean Elastic solid.

UNIT – II: BIOFLUID MECHANICS 9

Intrinsic fluid properties, Rheological properties of blood, Pressure-flow relationship for NonNewtonian Fluids, Fluid mechanics in straight tube, Structure of blood vessels, Material properties and modelling of Blood vessels, Heart – Cardiac muscle characterization, Native heart valves, Prosthetic heart valve fluid dynamics.

UNIT – III: MUSCULOSKELETAL MECHANICS 9

Constitutive equation of viscoelasticity – Maxwell, Voight and Kelvin models, anisotropy, Hard Tissues – Structure, viscoelastic properties, functional adaptation, Soft Tissues – Structure, functions, material properties and modelling of Soft Tissues – Cartilage, Tendons and Ligaments Skeletal Muscle, Bone fracture mechanics, Implants for bone fractures.

UNIT – IV: BIOMECHANICS OF JOINTS AND IMPLANTS 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: MODELLING AND ERGONOMICS 9

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

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Analyze and apply mechanical principles to biological systems.

CO2: Explain the fundamentals of biofluid mechanics in heart valve design and blood vessel modeling.

CO3: Discuss the mechanical characteristics of musculoskeletal elements for developing mathematical models of joints and implants.

CO4: Utilize biomechanical knowledge for analyzing human joints and motion.

CO5: Apply biomechanics to real-world issues, assessing impacts on health, safety, society, environment, and legal and ethical considerations.

TEXT BOOKS:

1. Y.C. Fung, Bio-Mechanics- Mechanical Properties of Tissues, Springer-Verlag, 1998.
2. Subrata Pal, Textbook of Biomechanics, Viva Books Private Limited, 2009.
3. Krishna B. Chandran, Ajit P. Yoganathan and Stanley E. Rittgers, Biofluid Mechanics:The Human Circulation, Taylor and Francis, 2007.

4. Özkaya, Nihat, Dawn Leger, David Goldsheyder, and Margareta Nordin. Fundamentals of biomechanics: equilibrium, motion, and deformation. Springer, 2016.

REFERENCE BOOKS:

1. Sheraz S. Malik and Shahbaz S. Malik, Orthopaedic Biomechanics Made Easy,Cambridge University Press, 2015.
2. Jay D. Humphrey, Sherry De Lange, An Introduction to Biomechanics: Solids and Fluids, Analysis and Design, Springer Science Business Media, 2004.
3. Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press 2007.
4. Neil J. Mansfeild, Human Response to Vibration, CRC Press, 2005. 5. Carl J. Payton, Biomechanical Evaluation of movement in sports and Exercise, 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
CO 1	3	1	1	-	-	1	-	1	-	-	-	1	1	-
CO 2	3	1	1	-	-	1	-	1	-	-	-	1	1	-
CO 3	3	1	1	-	-	1	-	1	-	-	-	1	1	-
CO 4	3	1	1	-	-	1	-	1	-	-	-	1	1	-
CO 5	3	1	1	-	-	1	-	1	-	-	-	1	1	-
Avg.	**3**	**1**	**1**	**-**	**-**	**1**	**-**	**1**	**-**	**-**	**-**	**1**	**1**	**-**

PMD302 **PHYSIOLOGICAL MODELING** **L T P C**

3 0 0 3

OBJECTIVES:

- To be familiar with the physiological models.
- To analyze the dynamic response characteristics and their control.
- To intrepret nonlinear models of physiological systems.
- To apply electrical analogies of circulatory system.
- To study about the real time examples of physiological systems.

UNIT – I: INTRODUCTION **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 of analysis Physiology.

UNIT – II: MODELING OF DYNAMIC SYSTEMS **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 **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: COMPARTMENTAL MODELLING **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 and warm bloodedness.

UNIT – V: CASE STUDY **9**

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:

On completion of the course, student will be able to

CO1: Analyze models based on their characteristics and system dynamics.

CO2: Utilize modeling techniques to describe dynamic physiological systems.

CO3: Evaluate the characteristics of nonlinear models of physiological systems.

CO4: Apply modeling techniques in circulatory system

CO5: Interpret modeling case studies to understand physiological processes.

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
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
Avg	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**-**	**3**	**-**	**2**	**2**	**2**

PMD303 REHABILITATION ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To understand the need for rehabilitation.
- To identify the importance of sensory augmentation and substitution.
- To learn the use of orthopedic prosthetics and orthotics in rehabilitation.
- To explore virtual reality in rehabilitation.
- To gain knowledge in rehabilitation medicine and advocacy.

UNIT – I: INTRODUCTION TO REHABILITATION 9

Definition - Impairments, disabilities and handicaps, Primary and secondary disabilities, Activities of daily living, Appropriate Technology, Residual function. Rehabilitation. Rehabilitation team – members and their functions. Rehabilitation care –Need for proper delivery of rehabilitation care, Community based rehabilitation and its aspects.

UNIT – II: ENGINEERING CONCEPTS IN SENSORY AUGMENTATION SUBSTITUTION 9

Sensory augmentation and substitution- Visual system: Visual augmentation, Tactual vision substitution, and Auditory vision substitution. Auditory system- Auditory augmentation, Hearing aids, cochlear implants, visual auditory substitution, tactual auditory substitution. Tactual system - Tactual augmentation, Tactual substitution

UNIT – III: ORTHOPEDIC PROSTHETICS AND ORTHOTICS 9

Engineering concepts in motor rehabilitation, Artificial limbs- body powered, externally powered and controlled orthotics and prosthetics, Myoelectric hand and arm prosthetics. Functional Electrical Stimulation systems-Restoration of hand function, restoration of standing and walking, Hybrid Assistive Systems (HAS).

UNIT – IV: VIRTUAL REALITY 9

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor

recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

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:

On completion of the course, student will be able to

CO1: Learn the key terminologies used by the rehabilitation team.

CO2: Illustrate Engineering Concepts in Sensory & Motor rehabilitation.

CO3: Design different orthotics and prosthetics for rehabilitation applications.

CO4: Summarize the need of virtual reality tools for different aids.

CO5: Explore the legal aspects for building rehabilitation aids for the needed people.

TEXT BOOKS:

1. Joseph D Bronzino, “The Biomedical Engineering Handbook”. 2nd edition, CRC Press, 2000.
2. Robinson C.J, “Rehabilitation Engineering”, CRC Press, 2006.

REFERENCE BOOKS:

1. Sashi S Kommu, “Rehabilitation Robotics”, 1st edition, CRC Press, 2007.
2. Sunder, “Textbooks of Rehabilitation”, Jaypee Brothers Medical Publishers Pvt. Ltd, New Delhi, 2nd Edition, Reprint 2007
3. Warren E. Finn, Peter G. Lopressor, “Handbook of Neuroprosthetic Methods”,CRC, 2002.
4. Roy A Cooper (Editor), Hisaichi Ohnabe (Editor), Douglas A. Hobson (Editor), “An Introduction to Rehabilitation Engineering (Series in Medical Physics and Biomedical Engineering” CRC Press, 2000.

5. Horia- Nocholai Teodorecu, L.C.Jain, “Intelligent systems and technologies in rehabilitation Engineering”, CRC; December 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**
CO1	3	1	1	-	-	1	-	1	-	-	-	-	2	1
CO2	3	1	1	2	-	1	-	1	-	-	-	-	2	1
CO3	3	1	1	2	-	1	-	1	-	-	-	-	2	1
CO4	3	1	1	2	-	1	-	1	-	-	-	-	2	1
CO5	3	1	1	-	-	1	-	1	-	-	-	-	2	1
Avg.	**3**	**1**	**1**	**2**	**-**	**1**	**-**	**1**	**-**	**-**	-	**-**	**2**	1

PMD304 **ASSISTIVE TECHNOLOGY** **L T P C**

3 0 0 3

OBJECTIVES:

- To grasp the principles, design, and applications of cardiac assist devices.
- To comprehend the principles of the hemodialysis machine.
- To gain knowledge about the constructional and functional characteristics of hearing implants.
- To explore the design aspects of prosthetic and orthotic devices.
- To be aware of the advancements in assistive technology.
-

UNIT – I: CARDIAC ASSIST DEVICES **9**

Principle of External counter pulsation techniques, intra-aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves.

UNIT – II: HEMODIALYSERS **9**

Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

UNIT – III: HEARING AIDS **9**

Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT – IV: PROSTHETIC AND ORTHODIC DEVICES **9**

Introduction to virtual reality, Virtual reality based rehabilitation, Hand motor recovery systems with Phantom haptics, Robotics and Virtual Reality Applications in Mobility Rehabilitation.

UNIT – V: RECENT TRENDS **9**

Transcutaneous electrical nerve stimulator, bio-feedback, smart prosthetics, Robotic limbs, knee brace, E-nose and automatic calender clock.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Interpret the various mechanical techniques that will help in assisting the heart functions.

CO2: Describe the underlying principles of hemodialyzer machine.

CO3: Indicate the methodologies to assess the hearing loss.

CO4: Evaluate the types of assistive devices for mobilization.

CO5: Explore about recent trends in assistive technology.

TEXT BOOKS:

1. Joseph D Bronzino, “The Biomedical Engineering Handbook”. 2nd edition, CRC Press, 2000.
2. Marion. A. Hersh, Michael A. Johnson,Assistive Technology for visually impaired and blind,Springer
3. Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, CRC Press, 1st edition,2010.Science & Business Media, 1st edition, 2010.

REFERENCE BOOKS:

1. Kenneth J. Turner Advances in Home Care Technologies: Results of the match Project, Springer, 1stedition, 2011.
2. Gerr M. Craddock Assistive Technology-Shaping the future, IOS Press, 1st edition, 2003.
3. 3D Printing in Orthopaedic Surgery, Matthew Dipaola , Elsevier 2019 ISBN 978 -0-323- 662116
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1
5. https://www.edtechreview.in/trends-insights/trends/latest-trends-in-assistive-technology-for-education/

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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

PMD305	ERGONOMICS	L T P C
		3 0 0 3

OBJECTIVES:

- To get exposed to principles of visual and auditory capabilities.
- To learn the mechanics of muscle physiology and significance of rest cycle.
- To explore spatial compatibility and the relation between control orders and control response.
- To assess about the measurements and proportions of the human body.
- To be familiar with the mathematical models, analysis and design of biomedical devices using case studies.

UNIT – I: VISUAL AND AUDITORY ERGONOMICS 9

Process of seeing – visual capabilities – factors affecting visual acuity and contrast sensitivity – human factor aspects of hard copy text and computer screen text, factors in selecting graphic representations symbols, qualitative visual display – process of hearing – principles of auditory display. Measures for monitoring control & mitigation.

UNIT – II: MUSCLE PHYSIOLOGY 9

Muscle physiology – muscle metabolism – respiratory response – joint motion study – measure of physiological in-efficiency and energy consumption – work rest cycles – aspects of manual and posture study, material handling (MMH) Bio-mechanical recommended limits of MMH.

UNIT – III: CONTROLS AND DISPLAYS 9

Spatial compatibility and physical arrangement of displays and controls - Design of displays and controls – movement capability – rotary controls and rotor displays movement of displays orientation of the operator and movement relationships control orders and control responses – human limitations in tracking task.

UNIT – IV: ANTHROPOMETRY 9

Anthropometry – anthropometric design principles – Physical work load and energy expenditure - work space envelope – factors in design of work space surfaces –

principles of seat design – principles of control panel. Ergonomic implications. Organization classification of human errors theories of accident causation-reducing accidents by altering behavior.

UNIT – V: CASE STUDIES 9

Case Study on computer design, control panel design of an electronic instrument, computer key board, hand drill . Biomedical Application, Design optimization of Medical Equipment.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Familiarize the principles of visual and auditory capabilities.

CO2: Recognize the significance of posture.

CO3: Acquire knowledge about tracking tasks.

CO4: Explore ergonomics and its impact across various domains.

CO5: Perform case study on electronic instruments and medical equipment.

TEXT BOOKS:

1. Pascale Carayon, “Handbook of Human Factors and Engineering”, Second Edition, CRC Press, 2011
2. Martin Helander, “Guide to Human Factors and Ergonomics”, Second Edition, CRC Press,2005
3. Benjamin W.Niebel, “Motion and Time Study”, Richard, D. Irwin Inc., Seventh Edition, 2002.

REFERENCE BOOKS:

1. Shrawan Kumar, Biomechanics in Ergonomics, Second Edition, CRC Press 2007.
2. George Kanawaty, “Introduction to work study”, ILO, 3rd edition, Oxford & IBH publishing, 2001.
3. Stephen Pheasant, Christine M. Haslegrave, Bodyspace: Anthropometry, Ergonomics and the Design of Work, CRC Press, 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
CO1	3	1	1	1	1	-	-	-	-	-	-	-	3	-
CO2	3	1	1	1	1	-	-	-	-	-	-	-	3	-
CO3	3	1	1	1	1	-	-	-	-	-	-	-	3	-
CO4	3	1	1	1	1	-	-	-	-	-	-	-	3	-
CO5	3	1	1	1	1	-	-	-	-	-	-	-	3	-
Average	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

PMD306 **HAPTICS** **L T P C**

3 0 0 3

OBJECTIVES:

Students able to:

- Expose to basic principles of Haptics and their property.
- Familiar about human haptic perception
- Express about machine haptics.
- Learn the concepts of computer haptics.
- Understand applications of haptics in medical profession.

UNIT – I: INTRODUCTION **9**

Touch, Sense of Touch, Perception of world through touch, Haptics, Tactile system, Tactile receptors, Sensory and Motor specialization of Hand, Haptic perception, Haptic Illusion, Tactile and Haptic Displays, Haptic exploration, Concepts and terminologies.

UNIT II: HUMAN HAPTIC PERCEPTION **9**

Touch and cognition, Human Haptic system: Mechanical structure of Arm, Hand haptics system, Human sensory system, The motor system, Haptic cognition, Haptic exploration, Concept of Illusion, Human perceptual parameters for Haptics: Interface development, Perception Thresholds

UNIT III: MACHINE HAPTICS **9**

Haptic Interfaces: Robotic perspective, Haptic interface system, HAVE sensor: Electromechanic sensors, Optical sensors, Capacitive sensor, Resistive sensor, Force sensors, strain gauge sensors, Magnetic sensor, HAVE actuators: Magnetic Levitation Devices, Nonholonomic devices, Magnetic sensors and parallel mechanisms, performance specifications: physical attributes, special attributes and temporal attributes

UNIT IV: COMPUTER HAPTICS **9**

Haptic rendering subsystems, Polygon, based representation and scene graph, collision detection techniques and bounding volumes, control methods for Haptic systems: Impedance control architecture, Feed, forward impedance control

architecture, positive feedback Impedance control architecture, Hybrid compensation Impedance control architecture, Admittance control architecture

UNIT V HAPTICS APPLICATIONS **9**

Haptics for Medical Applications: Surgical simulation, stoke based rehabilitation, support of the visually impaired, Tele, surgery, Media: Haptic broadcasting. E, commerce, Video games, other application: Mobile Haptics, Haptics and VR, Introduction to Wearable Haptic devices

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Explain the laws of principles of haptics

CO2: Discuss the behaviour of human haptics

CO3: Analyse the principles of machine haptics

CO4: Identify suitable computation for haptics

CO5: Describe the existing system models used in haptics.

TEXT BOOKS:

1. Lynette Jones, Haptics, The MIT Press, 2018
2. Abdulmotaleb El Saddik, Mauricio Orozco, Mohamad Eid, Jongeun Cha, Haptics Technologies: Bringing Touch to Multimedia, Springer Science & Business Media, 2011
3. Tom Bruno, Wearable Technology: Smart Watches to Google Glass for Libraries, Rowman & Littlefield Publishers, Lanham, Maryland, 2015.

REFERENCE BOOKS:

1. Hiroyuki Kajimoto, Masashi Konyo, Shoichi Hasegawa, Takuya Nojima, Ki-Uk Kyung, Haptic Interaction: Science, Engineering and Design. (2017). Switzerland: Springer Nature Singapore.
2. Abdulmotaleb El Saddik, Mauricio Orozco, Mohamad Eid, Jongeun Cha, Haptics TechnologiesBringing Touch to Multimedia, Springer, 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
CO 1	3	2	2	3	-	1	-	-	-	-	-	-	1	-
CO 2	3	2	3	2	-	1	-	-	-	-	-	-	1	-
CO 3	3	2	1	3	-	1	-	-	-	-	-	-	1	-
CO 4	3	3	2	2	-	1	-	-	-	-	-	-	1	-
CO 5	3	2	1	3	-	1	-	-	-	-	-	-	1	-
Avg.	3	2	2	2	-	1	-	-	-	-	-	-	1	-

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 4: SIGNAL AND IMAGE PROCESSING								
S.No	**Course Code**	**Course Title**	**Category**	**Contact Periods**				**C**
				L	**T**	**P**	**Total**	
1.	PMD401	Bio signal Processing	PEC	3	0	0	3	3
2.	PEC203	Speech Processing	PEC	3	0	0	3	3
3.	PMD402	Biometrics	PEC	3	0	0	3	3
4.	PMD403	Bio MEMS	PEC	3	0	0	3	3
5.	PMD404	Brain Computer Interface and its Applications	PEC	3	0	0	3	3
6.	PCS505	Computer Vision	PEC	3	0	0	3	3

PMD401	BIO SIGNAL PROCESSING	L T P C
		3 0 0 3

OBJECTIVES:

- To learn the concepts of bio signals and its spectral characteristics.
- To comprehend the concepts of linear and non-linear filtering techniques for extracting desired information.
- To analyze the principle of adaptive filtering and wavelet detection of bio signals.
- To explore the various techniques for automated classification and decision making to aid diagnosis.
- To acquire knowledge of time, frequency and multivariate analysis.

UNIT – I: BIOSIGNAL AND SPECTRAL CHARACTERISTICS 9

Characteristics of some dynamic biomedical signals, Noises- random, structured and physiological noises. Filters- IIR and FIR filters. Spectrum – power spectral density function, cross-spectral density and coherence function, cepstrum and homomorphic filtering. Estimation of mean of finite time signals.

UNIT – II: TIME SERIES ANALYSIS AND SPECTRAL ESTIMATION 9

Time series analysis – linear prediction models, process order estimation, lattice representation, non-stationary process, fixed segmentation, adaptive segmentation, application in EEG, PCG signals, Time varying analysis of Heart-rate variability, model based ECG simulator. Spectral estimation –Blackman Tukey method, periodogram, and model based estimation. Application in Heart rate variability, PCG signals.

UNIT – III: ADAPTIVE FILTERING AND WAVELET DETECTION 9

Filtering – LMS adaptive filter, adaptive noise canceling in ECG, improved adaptive filtering in ECG, Wavelet detection in ECG – structural features, matched filtering, adaptive wavelet detection, detection of overlapping wavelets.

UNIT – IV: BIOSIGNAL CLASSIFICATION AND RECOGNITION 9

Signal classification and recognition – Statistical signal classification, linear discriminant function, direct feature selection and ordering, Back propagation neural network based classification. Application in Normal versus Ectopic ECG beats.

UNIT – V: TIME FREQUENCY AND MULTIVARIATE ANALYSIS 9

Time frequency representation, spectrogram, Wigner distribution, Time-scale representation, scalogram, wavelet analysis – Data reduction techniques, ECG data compression, ECG characterization, Feature extraction- Wavelet packets, Multivariate component analysis-PCA, ICA.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Preprocess the Bio signals.

CO2: Analyze bio signals in time domain and estimate the spectrum.

CO3: Apply wavelet detection techniques for bio signal processing.

CO4: Classify Bio signals using neural networks and statistical classifiers.

CO5: Extract the features using multivariate component analysis.

TEXT BOOKS:

1. Rangaraj M. Rangayyan, “Biomedical Signal Analysis-A case study approach”, Wiley, 2nd Edition, 2016.
2. Willis J. Tompkins, “Biomedical Digital Signal Processing”, Prentice Hall of India, New Delhi, 2003.
3. Arnon Cohen, “Bio-Medical Signal Processing Vol I and Vol II”, CRC Press Inc., Boca Rato, Florida, 1999.

REFERENCE BOOKS:

1. Kayvan Najarian and Robert Splerstor, “Biomedical signals and Image processing’’, CRC – Taylor and Francis, New York, 2nd Edition, 2012.

2. K.P.Soman, K.Ramachandran, “Insight into wavelet from theory to practice”, PHI, New Delhi, 3rd Edition, 2010.
3. D.C.Reddy, “Biomedical Signal Processing – Principles and Techniques’’, Tata McGraw-Hill Publishing Co. Ltd, 2005.
4. John L.Semmlow, “Biosignal and Biomedical Image Processing Matlab Based applications’’, Taylor& Francis Inc, 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**
CO 1	3	1	1	1	1	-	-	1	2	2	-	-	1	2
CO 2	3	1	1	1	1	-	-	1	2	2	-	-	1	2
CO 3	3	1	1	1	1	-	-	1	2	2	-	-	1	2
CO 4	3	1	1	1	1	-	-	1	2	2	-	-	1	2
CO 5	3	1	1	1	1	-	-	1	2	2	-	-	1	2
Avg.	**3**	**1**	**1**	**1**	**1**	**-**	**-**	**1**	**2**	**2**	**-**	**-**	**1**	**2**

PEC203	SPEECH PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study about the fundamentals of speech and model speech production system.
- To analyse different speech features.
- To understand an appropriate statistical speech model for a given application.
- To learn the concepts of the speech recognition system.
- To explore the statistical modeling approaches and their implementation issues.
- To apply mathematical model in framing speech synthesis systems.

UNIT-I: SPEECH FUNDAMENTALS 9

Articulatory Phonetics – Production and Classification of Speech Sounds; Acoustic Phonetics – Acoustics of speech production; discrete time model of speech, Short-Time Fourier Transform. Basics of Linear prediction, autocorrelation method, Levinson Durbin algorithm, Pitch estimation using linear prediction analysis.

UNIT-II: FEATURE EXTRACTION 9

Feature Extraction - MFCC, LPCC and PLP. Speech distortion measures–mathematical and perceptual – Log–Spectral Distance, Cepstral Distances, Weighted Cepstral Distances Likelihood Distortions. Time alignment and normalization - dynamic time warping, multiple time alignment paths.

UNIT-III: SPEECH MODELING 9

Statistical modeling of speech - Gaussian mixture modeling, Hidden Markov models – Markov processes, HMMs - Probability Evaluation, optimal state sequence - Viterbi search, Baum-Welch parameter re-estimation.

UNIT-IV: SPEECH RECOGNITION 9

Large Vocabulary Continuous Speech Recognition: Architecture of a large vocabulary continuous speech recognition system – acoustics and language models – n-gram statistics, context dependent sub-word units. Speaker recognition - speaker identification and verification – acoustic models; Applications and current status.

UNIT-V: SPEECH SYNTHESIS 9

Text-to-Speech Synthesis: Concatenative and waveform synthesis methods, hidden Markov model based TTS, context dependent sub-word units for TTS, intelligibility and naturalness – role of prosody, Applications and current status.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the fundamentals of speech and model speech production system.
- Categorize the different approaches of speech synthesis system.
- Extract and compare different speech features.
- Design and implement a speech recognition system.
- Acquire knowledge in choosing an appropriate statistical speech model for a given application.
- Evaluate statistical modeling approaches and its implementation issues.

TEXT BOOKS:

1. Lawrence Rabiner and Biing-Hwang Juang, “Fundamentals of Speech Recognition”, Pearson Education, 2003.
2. Thomas F Quatieri, “Discrete-Time Speech Signal Processing – Principles and Practice”, Pearson 2012.
3. John Makhoul, “Linear prediction: a tutorial review” –Proceedings of the IEEE, Vol. 63, No. 4, Apr. 1975, pp. 561 – 580.

REFERENCES:

1. L. R. Rabiner and Schaffer, “Digital Processing of Speech Signals”, Pearson Education, 2013.
2. Ben Gold and Nelson Morgan, “Speech and Audio Signal Processing, Processing and Perception of Speech and Music”, Wiley- India Edition, 2011.
3. Heiga Zen, Keiichi Tokuda, Alan W. Black, "Statistical Parametric Speech Synthesis", Speech Communication, Vol. 51, Issue 11, Nov. 2009, pp. 1039 - 1064.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC204.1	2	2	2	2	-	-	-	-	-	-	-	2	2	2
PEC204.2	3	3	2	2	-	-	-	-	-	-	-	2	2	2
PEC204.3	3	3	2	2	-	-	-	-	-	-	-	2	2	2
PEC204.4	3	3	2	2	-	-	-	-	-	-	-	2	2	2
PEC204.5	3	3	2	2	-	-	-	-	-	-	-	2	2	2
PEC204.6	3	3	2	2	-	-	-	-	-	-	-	2	2	2
AVG	3	3	2	2	-	-	-	-	-	-	-	2	2	2

PMD402	BIOMETRICS	L T P C
		3 0 0 3

OBJECTIVES:

- To learn the general principles of design of biometric systems and the underlying application environment.
- To familiarize the concepts of finger print technology.
- To analyze the techniques of face recognition and hand geometry.
- To explore the requirements of iris recognition technology.
- To acquire knowledge about the evaluation of biometric systems.

UNIT – I: INTRODUCTION 9

Introduction and back ground – biometric technologies – passive biometrics – active biometrics – Biometric characteristics, Biometric applications – Biometric Authentication systems- Taxonomy of Application Environment, Accuracy in Biometric Systems- False match rate- False non match rate- Failure to enroll rate-Derived metrics-Biometrics and Privacy.

UNIT – II: FINGERPRINT TECHNOLOGY 9

General description of fingerprints- fingerprint sensors, fingerprint enhancement, Feature Extraction- Ridge orientation, ridge frequency, fingerprint matching techniques- correlation based, Minutiae based, Ridge feature based, fingerprint classification, Applications of fingerprints, Finger scan- strengths and weaknesses, Evaluation of fingerprint verification algorithms.

UNIT – III: FACE RECOGNITION AND HAND GEOMETRY 9

Introduction to face recognition, face recognition using PCA, LDA, face recognition using shape and texture, face detection in color images, 3D model based face recognition in video images, Neural networks for face recognition, Hand geometry – scanning – Feature Extraction – classification.

UNIT – IV: IRIS RECOGNITION 9

Introduction, Anatomical and Physiological underpinnings, Iris sensor, Iris representation and localization- Daugman and Wilde‘s approach, Iris matching,

Iris scan strengths and Weaknesses, System performance, future directions.

UNIT – V: VOICE SCAN AND MULTIMODAL BIOMETRICS **9**

Voice scan, speaker features, short term spectral feature extraction, Mel frequency cepstral coefficients, speaker matching, Gaussian mixture model, NIST speaker Recognition Evaluation Program, Introduction to multimodal biometric system – Integration strategies.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Assess the principles of biometric systems.

CO2: Examine the fingerprint recognition technique.

CO3: Analyze the face recognition and hand geometry system.

CO4: Describe the structure and function of iris recognition system.

CO5: Explore the speech recognition and multimodal biometric systems.

TEXT BOOKS:

1. James Wayman& Anil Jain, “Biometric Systems- Technology Design and Performance Evaluation”, SPRINGER (SIE), 1st Edition, 2011.
2. Paul Reid, “Biometrics for Network Security”, Pearson Education, 2004.
3. S.Y. Kung, S.H. Lin, M.W., “Biometric Authentication: A Machine Learning Approach”, Prentice Hall, 2005.

REFERENCE BOOKS:

1. Nalini K Ratha, Ruud Bolle, “Automatic fingerprint recognition system’’, Springer, 2003.
2. L C Jain, I Hayashi, S B Lee, U Halici, “Intelligent Biometric Techniques in Fingerprint and Face Recognition”, CRC Press, 1st Edition, 1999.
3. John Chirillo, Scott Blaul, “Implementing Biometric Security”, John Wiley & Sons, 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**
CO 1	3	-	-	-	-	-	-	3	1	1	-	-	2	2
CO 2	3	-	-	2	-	-	-	2	1	1	-	2	2	2
CO 3	3	-	-	2	-	-	-	2	1	1	-	2	2	2
CO 4	3	-	-	2	-	-	-	2	1	1	-	2	2	2
CO 5	3	-	-	-	-	-	-	2	1	1	-	2	2	2
Avg.	**3**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**1**	**1**	**-**	**2**	**2**	**2**

PMD403 **Bio MEMS** **L T P C**

3 0 0 3

OBJECTIVES:

- To learn the concepts of semiconductors and solid mechanics to fabricate MEMS devices.
- To familiarize the concepts of mechanical, thermal sensors and actuators.
- To analyze the principle of electrostatic, piezo-electric sensors and actuators.
- To explore the requirements of micro fluidic systems.
- To acquire knowledge about the applications of MEMS in different field of medicine.

UNIT – I: MEMS MATERIALS AND FABRICATION 9

Semiconductor materials; photo lithography; doping; thin film growth and deposition; CVD and Ion Implantation, metallization; wet and dry etching; silicon micromachining; metal MEMS processes; submicron optical lithography; electron beam lithography; soft lithography and printing.

UNIT – II: MECHANICAL AND THERMAL SENSORS AND ACTUATORS 9

Mechanical sensors and actuators – beam and 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, PIEZOELECTRIC SENSORS AND ACTUATORS 9

Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.

UNIT – IV: MICROFLUIDIC SYSTEMS 9

Laminar flow in circular conduits, fluid flow in micro conduits, in sub micrometer and nanoscale. microfluidic components (filters, mixers, valves, and pumps)

UNIT – V: APPLICATIONS **9**

CAD for MEMS, DNA sensor, MEMS based drug delivery, Biosensors- sensors for glucose, uric acid, urea and triglyceride sensor. Introduction to the MATLAB/Simulink/ CAD tool for modelling/simulations of bioelectronics systems.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Summarize various MEMS fabrication techniques.

CO2: Elucidate different types of mechanical and thermal sensors and actuators and their principles of operation.

CO3: Describe different types of various electrostatic and piezoelectric sensors, actuators and their principles of operation.

CO4: Explain the features of microfluidic systems.

CO5: Illustrate the applications of MEMS in different field of medicine.

TEXT BOOKS:

1. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata McGrawHill Publishing Company, New Delhi, 2017.
2. Wanjun Wang and Stephen A.Soper, Bio-MEMS:Technologies and Applications, CRC Press, NewYork, 2007.
3. Chang Liu, Foundations of MEMS, Pearson Education International, New Jersey, USA, 2012.
4. Ellis Meng, Biomedical Microsystems, CRC Press, Boca Raton, FL, 2011.

REFERENCE BOOKS:

1. P. Tabeling, S .Chen, Introduction to microfluidics, Oxford University Press, 2010.
2. Alok Pandya ,Vijai Singh, Micro/Nanofluidics and Lab-on-Chip Based Emerging Technologies for Biomedical and Translational Research Applications - Part B, Academic Press, 2022 .

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

PMD404 BRAIN COMPUTER INTERFACE AND ITS APPLICATIONS L T P C

3 0 0 3

OBJECTIVES:

- To grasp the basic concepts of brain computer interface.
- To familiarize the concepts of electrophysiological sources.
- To analyze the feature extraction methods.
- To explore the feature translation methods.
- To acquire knowledge about the applications of BCI.

UNIT – I: INTRODUCTION TO BCI 9

Fundamentals of BCI – Structure of BCI system – Classification of BCI – Invasive, Non-invasive and Partially invasive BCI – EEG signal acquisition - Signal Preprocessing – Artifacts removal.

UNIT – II: ELECTROPHYSIOLOGICAL SOURCES 9

Sensorimotor activity – Mu rhythm, Movement Related Potentials – Slow Cortical Potentials-P300 - Visual Evoked Potential - Activity of Neural Cells - Multiple Neuro mechanisms.

UNIT – III: FEATURE EXTRACTION METHODS 9

Time/Space Methods – Fourier Transform, PSD – Wavelets – Parametric Methods – AR, MA, ARMA models – PCA – Linear and Non-Linear Features.

UNIT – IV: FEATURE TRANSLATION METHODS 9

Linear Discriminant Analysis – Support Vector Machines - Regression – Vector Quantization– Gaussian Mixture Modelling – Hidden Markov modelling – Neural Networks.

UNIT – V: APPLICATIONS 9

Functional restoration using Neuroprosthesis - Functional Electrical Stimulation, Visual Feedback and control - External device control, Case study: Brain actuated control of mobile Robot.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Describe BCI system and its potential applications.

CO2: Analyze event related potentials and sensory motor rhythms.

CO3: Compute features suitable for BCI.

CO4: Design classifier for a BCI system.

CO5: Explore the BCI for various applications.

TEXT BOOKS:

1. Bernhard Graimann, Brendan Allison, Gert Pfurtscheller, “Brain-Computer Interfaces: Revolutionizing Human-Computer Interaction”, Springer, 2010.
2. Arnon Kohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, Boca Rato, Florida, 1986.

REFERENCE BOOKS:

1. R. Spehlmann, “EEG Primer”, Elsevier Biomedical Press, 1981.
2. Bishop C.M., “Neural Networks for Pattern Recognition”, Oxford, Clarendon Press, 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**
CO 1	3	2	1	1	2	-	-	1	1	1	-	-	2	1
CO 2	3	2	1	1	2	-	-	1	1	1	-	-	2	1
CO 3	3	2	1	1	2	-	-	1	1	1	-	-	2	1
CO 4	3	2	1	1	2	-	-	1	1	1	-	-	2	1
CO 5	3	2	1	1	2	-	-	1	1	1	-	-	2	1
Avg.	3	2	1	1	1	-	-	**1**	**1**	**1**	-	-	**2**	1

PCS505	COMPUTER VISION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To grasp the basic concepts of image formation and processing.
- To learn feature detection, matching and detection
- To become familiar with feature based alignment and motion estimation.
- To develop skills on 3D reconstruction
- To understand image based rendering and recognition
- To apply the processing, mining of visual content surveillance, advanced
- rendering.

UNIT-I: INTRODUCTION TO IMAGE FORMATION AND PROCESSING **9**

Computer Vision - Geometric primitives and transformations - Photometric image formation – The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT-II: FEATURE DETECTION, MATCHING AND SEGMENTATION **9**

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT-III: FEATURE-BASED ALIGNMENT & MOTION ESTIMATION **9**

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment - Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion - Optical flow - Layered motion.

UNIT-IV: 3D RECONSTRUCTION **9**

Shape from X - Active rangefinding - Surface representations - Point-based representations-Volumetric representations - Model-based reconstruction -

Recovering texture maps and albedosos.

UNIT-V: IMAGE-BASED RENDERING AND RECOGNITION 9

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition - Category recognition - Context and scene understanding-Recognition databases and test sets.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

CO1: To understand basic knowledge, theories and methods in image processing and computer vision.

CO2: To implement basic and some advanced image processing techniques in OpenCV.

CO3: To apply 2D a feature-based based image alignment, segmentation and motion estimations.

CO4: To apply 3D image reconstruction techniques

CO5: To design and develop innovative image processing and computer vision applications.

TEXT BOOKS:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004

REFERENCES:

1. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006

2. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
3. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Addison-Wesley, 1992.

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC206.1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC206.2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC206.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC206.4	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC206.5	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC206.6	3	3	3	3	-	-	-	-	-	-	-	-	3	3
AVG	3	3	3	3	-	-	-	-	-	-	-	-	3	3

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 5: COMMUNICATION								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1.	PEC607	Communication Networks	PEC	3	0	0	3	3
2.	PMD501	Wireless Communication Techniques	PEC	3	0	0	3	3
3.	PMD502	Wearable devices	PEC	3	0	0	3	3
4.	PMD503	Medical Informatics	PEC	3	0	0	3	3
5.	PMD504	Telemedicine	PEC	3	0	0	3	3
6.	PMD505	Virtual Reality and Augmented Reality in Healthcare	PEC	3	0	0	3	3

PEC607 COMMUNICATION NETWORKS L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

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

UNIT - I: FUNDAMENTALS & LINK LAYER 9

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

UNIT - II: MEDIA ACCESS & INTERNETWORKING 9

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

UNIT - III: LOGICAL ADDRESSING AND ROUTING 9

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

UNIT - IV: TRANSPORT LAYER 9

Introduction to Transport layer –Protocols- User Datagram Protocols (UDP) and

Transmission Control Protocols (TCP) –Services – Features – TCP Connection – State Transition Diagram – Flow, Error and Congestion Control - Congestion avoidance (DECbit, RED) – QoS – Application requirements.

UNIT - V: APPLICATION LAYER 9

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

TOTAL PERIODS: 45

OUTCOMES:

The student should be able to:

CO1: Identify the components required to build different types of networks.

CO2: Choose the required functionality at each layer for given application.

CO3: Recognize IEEE standard employed in computer networking.

CO4: Trace the flow of information from one node to another node in the network.

CO5: Explain the functions of Application layer paradigms and Protocols.

TEXT BOOKS:

1. Behrouz A. Forouzan, “Data communication and Networking”, Fifth Edition, TataMcGraw – Hill, 2013.
2. James F. Kurose, Keith W. Ross, “Computer Networking - A Top-Down ApproachFeaturing the Internet”, Seventh Edition, Pearson Education, 2016.

REFERENCE BOOKS:

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

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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

PMD501	WIRELESS COMMUNICATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Cellular System.
- To analyze Mobile Radio Propagation mechanisms.
- To interpret the concepts of diversity and equalization techniques.
- To familiarize the importance of multiple access techniques.
- To discriminate the conventional and MIMO communications.

UNIT-I: CELLULAR SYSTEM FUNDAMENTALS 9

Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies: Prioritizing Handoffs, Practical Handoff Considerations, Co-Channel and Adjacent Channel Interference, Power Control for Reducing Interference, Improving Coverage and Capacity in Cellular Systems.

UNIT-II: MOBILE RADIO PROPAGATION 9

Introduction to Radio Wave Propagation, Basic Propagation Mechanisms, Path Loss models, Small Scale Fading and Multipath Propagation, Factors Influencing Small-Scale Fading, Parameters of mobile multipath channel, Types of Small- Scale Fading: Fading Effects Due to Multipath Time Delay Spread and Doppler Spread.

UNIT-III: EQUALIZATION AND DIVERSITY TECHNIQUES 9

Introduction, Linear, non- linear and adaptive equalization techniques, Diversity Techniques: Polarization Diversity, Frequency Diversity, Time Diversity, Practical Diversity Considerations.

UNIT-IV: MULTIPLE ACCESS TECHNIQUES 9

Introduction: Introduction To Multiple Access- Frequency Division Multiple Access(FDMA)- Time Division Multiple Access(TDMA)- Spread Spectrum Multiple Access-Code Division Multiple Access(CDMA)- Space Division Multiple Access (SDMA).

UNIT-V: MIMO COMMUNICATIONS (Qualitative Treatments) 9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain: Beam forming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spatial Multiplexing and BLAST Architectures.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Design a cellular system based on resource availability and traffic demands.
- Describe about Mobile Radio Propagation and apply the propagation mechanisms in various scenarios.
- Analyze the Concepts Of Multiple Access Techniques.
- Understand the mathematics behind the capacity calculation under different channel conditions.
- Understand the implication of diversity combining methods and the knowledge of channel.

TEXT BOOKS:

1. Andreas.F. Molisch, —Wireless Communications", John Wiley – India, 2011.
2. Wireless Communication –Andrea Goldsmith, Cambridge University Press, 2020.
3. Rappaport,T.S.,-Wireless communications", Pearson Education, Second Edition, 2010.

REFERENCES:

1. David Tse and Pramod Viswanath, Fundamentals of wireless communications, Cambridge University Press, First Edition, 2012

2. Wireless Communication and Networks –William Stallings ,Pearson Education, Second Edition 2005.
3. Upena Dalal, “Wireless Communication”, Oxford Higher Education, 2009.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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

PMD502 **WEARABLE DEVICES** **L T P C**

3 0 0 3

OBJECTIVES:

- To study about sensors and its application in wearable systems.
- To familiarize about sensor design and signal acquisition.
- To gain knowledge in energy harvesting methods for wearable systems.
- To comprehend the need for wireless technology in wearable systems and applications of smart fabrics.
- To learn about applications of wearable systems.

UNIT – I: SENSORS **9**

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems-Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

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 **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 AND SMART TEXTILE WITH BAN **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 - Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study smart fabric for monitoring biological parameters - ECG, respiration.

UNIT – V: APPLICATIONS 9

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

TOTAL PERIODS:45

COURSE OUTCOMES:

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

CO1: Explain need of wireless health systems and the application of wearable systems.

CO2: Identify the key design criteria and suggest an appropriate wearable Sensor approach which is most likely to meet a specific biosensor application.

CO3: Apply the energy harvesting techniques in the wearable devices.

CO4: Design wireless body area networks and Smart Fabrics.

CO5: Develop the wearable device for patient monitoring applications.

TEXT BOOKS:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011.
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013.
3. Edward Sazonov and Micheal R Neuman, Wearable Sensors:
4. Fundamentals, Implementation and Applications, Elsevier, 2014.
5. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology,Implementation applications, Pan Stanford Publishing Pte. Ltd, Singapore, 2012.

REFERENCE BOOKS:

1. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
2. Guang-Zhong Yang, Body Sensor Networks, Springer, 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
CO1	3	2	1	1	2	-	-	1	-	-	-	-	3	1
CO2	3	2	1	1	2	-	-	1	-	-	-	-	3	1
CO3	3	2	1	1	2	-	-	1	-	-	-	-	3	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	3	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	3	1
Avg	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**3**	**1**

PMD503 **MEDICAL INFORMATICS** **L T P C**

3 0 0 3

OBJECTIVES:

- Explore medical informatics' structure, internet integration, security, retrieval, and functionality.
- Incorporate advanced automated technologies and intelligent systems into clinical operations.
- Integrate computer-assisted history-taking, CPR functionality, and clinical systems for efficiency.
- Utilize neural networks, expert systems, and decision support for healthcare.
- Leverage virtual reality for medical training, surgery, telemedicine, and patient education.

UNIT – I: INTRODUCTION **9**

Introduction - Structure of Medical Informatics –Internet and Medicine -Security issues , Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics – Medical Informatics, Bioinformatics.

UNIT – II: COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING **9**

Automated clinical laboratories, Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computerized ECG, EEG and EMG, Computer assisted medical imaging- nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT – III: COMPUTER BASED PATIENT RECORD **9**

Introduction - History taking by computer, Dialogue with the computer, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology- Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT – IV: COMPUTER ASSISTED MEDICAL DECISION-MAKING 9

Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system-production rule system. cognitive model, semantic networks, decisions analysis in clinical medicine- computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT–V: RECENTTRENDS 9

Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, and computer assisted instruction in medicine.

TOTAL PERIODS: 45

COURSE OUTCOMES:

CO1: Explain the structure and functional capabilities of Hospital Information System.

CO2: Describe the need of computers in medical imaging and automated clinical laboratory.

CO3: Examine the functioning of information storage and retrieval in computerized patient record system.

CO4: Apply the suitable decision support system for automated clinical diagnosis.

CO5: Summarize the application of virtual reality and telehealth technology in medical industry.

TEXT BOOKS:

1. Y Mohan Bansal, “Medical informatics”, Tata McGraw Hill Publishing Ltd, 2003.
2. R.D.Lele, “Computers in medicine progress in medical informatics”, Tata Mcgraw Hill,2005

REFERENCE BOOKS:

1. Kathryn J. Hannah, Marion J Ball, “Health Informatics”, 3rd Edition, Springer, 2006.

2. Robert E. Hoyt , Ann Yoshihashi, “Medical Informatics: Practical Guide for Healthcare and Information Technology Professionals”, 4th edition, Lulu.com;,2010.Edward H. Shortliffe , James J. Cimino, “Biomedical Informatics: Computer Applications in Health Care and Biomedicine”, Springer-Verlag New York Inc.; 3rd ed. 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
CO1	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO2	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO3	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	1
Avg.	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**

PMD504	TELEMEDICINE	L T P C
		3 0 0 3

OBJECTIVES:

- To explore the evolution and historical development of telemedicine and healthcare.
- To examine different communication technologies in telemedicine.
- To investigate the ethical and legal considerations surrounding telemedicine.
- To analyze the architecture of picture archiving and communication system.
- To gain knowledge about applications of telemedicine.

UNIT – I: FUNDAMENTALS **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 **9**

Audio, video, still images, text and data, internet, air/ wireless communications, GSM satellite, micro wave, Mobile health and ubiquitous healthcare.

UNIT – III: ETHICAL AND LEGAL ASPECTS **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.

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 **9**

Teleradiology, telepathology, telecardiology, teleoncology, teledermatology, telesurgery.

TOTAL PERIODS: 45

COURSE OUTCOMES:

CO1: Analyze the fundamentals of telemedicine.

CO2: Assess the effectiveness of various communication technologies and information systems in telemedicine applications.

CO3: Apply ethical and legal aspects in telemedicine.

CO4: Evaluate the architecture of picture archiving and communication system.

CO5: Implement the various applications in telemedicine.

TEXT BOOKS:

1. Olga Ferrer Roca, Marcelo Sosa Iudicissa, “Handbook of Telemedicine”, IOS Press, Netherland, 3. 2002.
2. Khandpur R S, “TELEMEDICINE – Technology and Applications”, PHI Learning Pvt Ltd., New Delhi, 2017.
3. Norris A C, “Essentials of Telemedicine and Telecare”, John Wiley, New York, 2002

REFERENCE BOOKS:

1. H K Huang, “PACS and Imaging Informatics: Basic Principles and Applications” Wiley, New Jersey, 2010.
2. Khandpur R S, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, New Delhi, 2003.
3. Keith J Dreyer, Amit Mehta, James H Thrall, “Pacs: A Guide to the Digital Revolution”, Springer, New York, 2002.
4. Garrett Grolemund, Hands–On Programming with R, O'Reilly , 1 edition , 2014.

5. Michael Dawson, Python Programming for the Absolute Beginner, Course Technology , 3rd edition ,2010
6. Magesh Jayakumar, Arduino and Android Using Mit App Inventor, Createspace Independent Publishing Platform , 1.0 edition ,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
CO1	3	2	1	1	2	-	-	-	-	-	-	-	2	1
CO2	3	2	1	1	2	-	-	-	-	-	-	-	2	1
CO3	3	2	1	1	2	-	-	-	-	-	-	-	2	1
CO4	3	2	1	1	2	-	-	-	-	-	-	-	2	1
CO5	3	2	1	1	2	-	-	-	-	-	-	-	2	1
Avg.	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**1**

PMD505 VIRTUAL REALITY AND AUGMENTED REALITY IN HEALTHCARE **L T P C 3 0 0 3**

OBJECTIVES:

- To explore the components of virtual reality system.
- To grasp the basic principle of virtual reality modeling.
- To evaluate the usability of VR systems and methodologies for creating VR content.
- To examine the pros and cons of VR development for the web and mobile.
- To enumerate the applications in medical, military and real time.

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 **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: APPLICATIONS9

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

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Familiarize the components and principles of VR systems.

CO2: Apply VR modeling process.

CO3: Design and create VR content using appropriate methodologies.

CO4: Develop VR applications for web and mobile platforms.

CO5: Explore diverse VR applications.

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.

REFERENCE BOOKS:

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.

ONLINE RESOURCES

http://www.vrtechnology.org/resources.html

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
CO1	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO2	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO3	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO4	3	2	1	1	2	-	-	1	-	-	-	-	1	1
CO5	3	2	1	1	2	-	-	1	-	-	-	-	1	1
Avg.	**3**	**2**	**1**	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**1**	**1**

VERTICAL 6: ADVANCED HEALTH CARE DEVICES								
S.No	**Course Code**	**Course Title**	**Category**	**Contact Periods**				**C**
				L	**T**	**P**	**Total**	
1.	PMD601	Medical Expert Systems	PEC	3	0	0	3	3
2.	PMD602	Human Assist Devices	PEC	3	0	0	3	3
3.	PMD603	Critical Care Equipment	PEC	3	0	0	3	3
4.	PMD604	Advancement in Diagnostic and Therapeutic Equipment	PEC	3	0	0	3	3
5.	PMD605	Robotics in Medicine	PEC	3	0	0	3	3
6.	PMD606	Advancements in Healthcare Technology	PEC	3	0	0	3	3

PMD601 **MEDICAL EXPERT SYSTEMS** **L T P C**

3 0 0 3

OBJECTIVES:

The student should be made:

- To explore different algorithms used in Artificial Intelligence.
- To gain knowledge for solving problem in Artificial Intelligence.
- To apply, build and modify decision models to solve real problems.
- To familiar about learning and decision making models.
- To comprehend the concepts used in AI based medical expert systems

UNIT – I: INTRODUCTION TO AI **9**

Definition of AI – importance of AI –Machine Learning, Deep Learning, Various Learning Methods, Problem spaces and searches -Blind search strategies; Breadth first - Depth first –Heuristic search techniques Hill climbing - Best first – A* algorithm AO* algorithm, 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. Decision Making.

UNIT – V: APPLICATIONS **9**

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

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Understand the importance of Artificial Intelligence and expert systems

CO2: Apply, build and modify decision models to solve real problems.

CO3: Design an Artificial Intelligence Based Decision Support Systems.

CO4: Discuss the role of expert systems in learning and decision making.

CO5: Explore the applications of Artificial Intelligence Based Decision Support System.

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TEXT BOOKS:

1. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", First Edition, Pearson, 2015.
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", Sixth 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-2005.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PROGRAM OUTCOMES												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	3	2	-	-	-	-	2	-	2	-	-	-	3	2
CO 2	-	3	-	-	3	-	-	2	-	-	-	-	3	3
CO 3	-	3	-	-	3	-	-	-	1	-	-	-	3	2
CO 4	-	3	1	2	-	-	-	-	-	-	-	-	-	2
CO 5	-	3	-	-	2	2	1	-	3	-	-	-	3	3
Avg.	**3**	**3**	1	**2**	**3**	**2**	**1**	**2**	**2**	**-**	**-**	**-**	**3**	**2**

PMD602	HUMAN ASSIST DEVICES	L T P C
		3 0 0 3

OBJECTIVES:

The student should 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 comprehend the value of rehabilitation and its related components.

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 9

Incidence and Epidemiology- Rehabilitation of an Amputee- Problems in Stump- Immediate Postoperative Prosthetic Fitting- Prosthesis in Foot and Ankle Amputation, 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:

On completion of the course, student will be able to

CO1: Be familiar with the role and importance of assist devices.

CO2: Define and explain the basic function of the major components of a prosthesis, orthosis terminology.

CO3: Explore the advancement in visual prosthesis.

CO4: Learn the Constructional and functional characteristics of hearing implants.

CO5: 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”, Fourth Edition: Three Volume Set, CRC Press, 2015.
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 1998.

4. R.S. Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, Third 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
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
CO1	3	2	3	-	-	3	-	-	-	-	-	3	2	-
Avg	3	2		3	3	3	2	2	-	-	-	3	2	3

PMD603	CRITICAL CARE EQUIPMENT	L T P C
		3 0 0 3

OBJECTIVES:

The student should be made:

- To provide a comprehensive grasp of different intensive care equipment and their functionality.
- To get knowledge about various dialyzers and defibrillator.
- To comprehend the significance of various operation theatre equipment.
- To explore the concept of centralized systems.
- To grasp the importance of patient safety.

UNIT I INTENSIVE CARE UNIT EQUIPMENT 9

Suction apparatus, Different types; Sterilizers, Chemical, Radiation, Steam for small and large units. ICU ventilators. Automated drug delivery systems, Infusion pumps, components of drug infusion system, closed loop control infusion system, implantable infusion system. BMD Measurements – SXA – DXA - Quantitative ultrasound bone densitometer

UNIT II MEDICAL DEVICES AND EQUIPMENTS 9

Defibrillators, Hemodialysis Machine, Different types of Dialyzers, Membranes, Machine controls and measurements. Heart Lung Machine, different types of oxygenators, peristaltic pumps, Incubators.

UNIT III OPERATION THEATRE EQUIPMENT 9

Craniotomy, Electrosurgical Machines (ESU), electrosurgical analyzers, surgical aspirator, Instruments for operation. Anesthesia Machine, Humidification, Sterilization aspects, Boyles apparatus. Endoscopy – Laparoscopy - Cryogenic Equipment - Anesthesia gas, Anesthesia gas monitor, - surgical microscope.

UNIT IV CENTRALISED SYSTEMS 9

Centralized Oxygen, Nitrogen, Air supply & Suction. Centralized Air Conditioning, Operation Theatre table & Lighting. C Arm.

UNIT V PATIENT SAFETY 9

Patient electrical safety, Types of hazards, Natural protective mechanisms against electricity, Leakage current, Inspection of grounding and patient isolation, Hazards in operation rooms, ICCU and IMCUs, Opto couplers and Pulse transformers.

TOTAL:45 PERIODS

COURSE OUTCOMES:

The student should be able to:

- Comprehend the functioning of ICU monitoring equipment.
- Examine appropriate surgical tools and equipment used in critical care.
- Evaluate the operating theatre equipment depending on its use.
- Analyze the importance of centralized systems in hospitals.
- Explore the significance of patient electrical safety.

TEXT BOOKS

1. John G. Webster, “Medical Instrumentation Application and Design”, 4th edition, Wiley India Pvt Ltd, New Delhi, 2015
2. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”,Pearson education, 2012
3. Khandpur. R.S.,“Handbook of Biomedical Instrumentation”. Second Edition. Tata McGraw-Hill Pub. Co., Ltd. 2003.

REFERENCES

1. L.A Geddes and L.E.Baker, “Principles of Applied Biomedical Instrumentation”, 3rd Edition,2008.
2. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Pearson Education, NewDelhi, 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
CO1	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO2	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO3	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO4	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO5	3	2	1	1	1	-	-	-	-	-	-	-	1	-
Avg	3	2	1	1	1	-	-	-	-	-	-	-	1	-

PMD604 ADVANCEMENT IN DIAGONOSTIC AND THERAPEUTIC EQUIPMENT **L T P C**

3 0 0 3

OBJECTIVES:

- Explore the devices for measurement of parameters related to cardiology.
- Illustrate the recording and measurement of EEG.
- Examine EMG recording unit and its uses.
- Analyze the diagnostic and therapeutic devices related to respiratory parameters.
- Comprehend the clinical significance of diverse sensory measurements.

UNIT – I: CARDIAC EQUIPMENT **9**

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator-Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter.

UNIT – II: NEUROLOGICAL EQUIPMENT **9**

Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential–Visual, Auditory and Somatosensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation. EEG system maintenance and troubleshooting.

UNIT – III: MUSCULAR AND BIOMECHANICAL EQUIPMENT **9**

Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation. Static Measurement – Load Cell, Pedobarograph. Dynamic Measurement – Velocity, Acceleration, GAIT, Limb position.

UNIT – IV: RESPIRATORY MEASUREMENT AND ASSIST SYSTEM **9**

Instrumentation for measuring the mechanics of breathing – Spirometer -Lung Volume

and vital capacity, measurements of residual volume, Pneumotachometer – Airway resistance measurement, Whole body Plethysmograph, Intra-Alveolar and Thoracic pressure measurements, Apnoea Monitor. Types of Ventilators – Pressure, Volume, and Time controlled. Flow, Patient Cycle Ventilators, Humidifiers, Nebulizers, Inhalators.

UNIT – V: SENSORY DIAGNOSTIC EQUIPMENT 9

Psychophysiological Measurements – polygraph, basal skin resistance (BSR), galvanic skin resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

TOTAL PERIODS: 45

COURSE OUTCOMES:

CO1: Describe the working and recording setup of all basic cardiac equipment.

CO2: Assess the working and recording of all basic neurological equipment's.

CO3: Analyze the recording of diagnostic and therapeutic equipment's related to EMG.

CO4: Explain about measurements of parameters related to respiratory system.

CO5: Describe the measurement techniques of sensory responses.

TEXT BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India PvtLtd,New Delhi, 2015
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012.

REFERENCE BOOKS:

1. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, 2008.

2. Khandpur. R.S.,"Handbook of Biomedical Instrumentation". Second Edition.

Tata McGrawHill Pub. Co.,Ltd. 2003.

3. Antony Y.K.Chan, ”Biomedical Device Technology, Principles and design”, Charles Thomas Publisher Ltd, Illinois, USA, 2008.
4. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Pearson 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
CO 1	3	2	1	-	1	-	-	-	-	-	-	1	2	3
CO 2	3	2	1	-	1	-	-	-	-	-	-	1	2	3
CO 3	3	2	1	-	1	-	-	-	-	-	-	1	2	3
CO 4	3	2	1	-	1	-	-	-	-	-	-	1	2	3
CO 5	3	2	1	-	1	-	-	-	-	-	-	1	2	3
Avg.	3	2	1	-	1	-	-	-	-	-	-	1	2	3

PMD605	ROBOTICS IN MEDICINE	L T P C
		3 0 0 3

OBJECTIVES:

Students should be able:

- To get introduced to the fundamental of robotics and position analysis.
- To comprehend about parallel robots, different types of motions and force analysis.
- To explore the basics of trajectory planning, motion control systems and actuators.
- To have an insight into various sensors and vision systems.
- To apply fuzzy control and applications of robotics in medicine.

UNIT – I: FUNDAMENTALS AND POSITION ANALYSIS 9

Fundamentals – Classification, Advantages and disadvantages, Components, Degrees of freedom, Joints, Coordinates, Reference frames, Programming modes, Characteristics, Workspace, Languages, Collaborative robots, Position analysis – Robots as mechanisms, Conventions, Transformations, Forward and inverse kinematics, Denavit Hartenberg Representation, Degeneracy and Dextrerity, Screw based robots, Position analysis of Articulated Robot, Case studies.

UNIT II: PARALLEL ROBOTS, DIFFERENTIAL MOTIONS AND FORCE ANALYSIS 9

Parallel robots – Physical characteristics, Forward and Inverse Kinematic approaches, Planar and Spatial parallel robots, Differential relationships, The Jacobian, Large scale motions, Frame vs Robot, Differential motions and change, Hand frame, Operator, Jacobian and Inverse for Screw based and Parallel Robots, Differential operator, Lagarangian mechanics, Moments of Inertia, Dynamic Equations of Multiple DOF Robots, Static force analysis, Transformation of forces and moments between coordinate frames, Case studies.

UNIT III: TRAJECTORY PLANNING, MOTION CONTROL SYSTEMS AND ACTUATORS **9**

Path and Trajectory, Joint Space and Cartesian Space Descriptions and Trajectory Planning, Cartesian, Trajectory Recording, Basics, Block diagrams, Laplace Transform, Block diagram Algebra, Transfer Functions, Characteristic equation, Steady state error, Root locus, Proportional, Integral and Derivative controllers, Compensators, Bode, Loops, Multiple IO systems, Control - State space and Digital, Nonlinear systems, Characteristics of Hydraulic, Pneumatic, Electric motors, Other actuators, Speed reduction. Case studies.

UNIT IV: SENSORS, IMAGE PROCESSING AND ANALYSIS WITH VISION SYSTEMS **9**

Sensor Characteristics, Position, Velocity, Acceleration, Force, Pressure and Torque, Micro switches, Visible and IR, Touch, Proximity, Range finders, Sniff, Vision, Transforms – Fourier, Hough, Resolution, Quantization, Sampling, Image processing, Segmentation, Region growing and splitting, Operations, Object recognition, Depth, Specialized lighting, Compression, Colour images, Heuristics, Case studies.

UNIT V FUZZY CONTROL AND APPLICATIONS IN MEDICINE **9**

Fuzzy control - Crisp vs Fuzzy, Sets, Inference rules, Defuzzification, Simulation, Applications in Biomedical Engineering, Applications in rehabilitation, Nanobots in medicine, Clinical diagnosis and Surgery – Cardiac and abdominal procedures with teleoperated robots, Orthopedic surgery with cooperative robots, Case studies.

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

CO1: Describe the fundamental of robotics and position analysis.

CO2: Outline the functioning of parallel robots, different types of motions and force analysis.

CO3: Portray the basics of trajectory planning, Motion control systems and actuators.

CO4: Recognize and explain the use of various sensors and vision systems in robotics.

CO5: Employ Fuzzy control in robotics and apply it to Robotics in Medicine.

TEXT BOOKS:

1. S. B. Niku, Introduction to Robotics, Analysis, Control, Applications, Pearson Education, 2020
2. Robert Schilling, Fundamentals of Robotics-Analysis and control, Prentice Hall of India, 2003.
3. Fu Gonzales and Lee, Robotics, McGraw Hill, 1987.
4. J Craig, Introduction to Robotics, Pearson Education, 2005.

REFERENCE BOOKS:

1. Grover, Wiess, Nagel and Oderey, Industrial Robotics, McGraw Hill, 2012.
2. Klafter, Chmielewski and Negin, Robot Engineering, Prentice Hall Of India, 1989.
3. Mittal, Nagrath, Robotics and Control, Tata McGraw Hill publications, 2003.
4. Bijay K. Ghosh, Ning Xi, T.J. Tarn, Control in Robotics and Automation Sensor – Based integration, Academic Press, 1999.
5. Mikell P. Groover, Mitchell Weiss, Industrial robotics, technology, Programming and Applications, McGraw Hill International Editions, 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**
CO 1	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO 2	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO 3	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO 4	3	2	1	1	1	-	-	-	-	-	-	-	1	-
CO 5	3	2	1	1	1	-	-	-	-	-	-	-	1	-
Avg.	**3**	**2**	**1**	**1**	**1**	**-**	-	-	-	-	-	-	**1**	**-**

PMD606 ADVANCEMENTS IN HEALTHCARE TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES:

The student should be made:

- To educate on the laws and regulations that regulate digital healthcare.
- To acquire insights in digital radiology in hospitals.
- To comprehend the latest trends in E-health.
- To explore the different wearable devices used in healthcare.
- To gain knowledge on device interoperability and requirements for healthcare system development.

UNIT I DIGITAL HEALTH 9

Digital Health: Requirements and best practices, Laws and regulations in Digital health, Ethical issues, barriers, and strategies for innovation, Regulations of digital healthcare in India and Asia.

UNIT II DIGITAL RADIOLOGY 9

Digital radiology for digital hospital, picture archiving and communication, system integration, digital history of radiology, medical image archives, storage and networks.

UNIT III E-HEALTH 9

E-Health: Health care networking, medical reporting using speech recognition, physiological tests and functional diagnosis with digital methods, tele-consultation in medicine and radiology.

UNIT IV M-HEALTH CARE AND WEARABLE DEVICES 9

Introduction to mobile healthcare devices-economy-average length of stay in hospital, outpatient care, health care costs, mobile phones, 4G, smart devices, wearable devices, Uptake of e-health and m-health technologies. Standards, system Design and case study.

UNIT V MODALITY AND STANDARDS FOR INTER-OPERABILITY 9

Multimodality registration in daily clinical practice. Mobile healthcare. Selection and Implementation in e-Health project, design of medical equipment based on user needs. Security and privacy in digital health care. Case study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

The student should be able to:

- Explain the necessity for digital medical record management.
- Describe the need for digital radiology.
- Make changes to the E-Health work flow tools and procedures.
- Provide a list of the technologies that are available for wearable medical equipment.
- Compare device interoperability, requirements for healthcare system development.

TEXT BOOKS

1. Christoph Thuemmler, Chunxue Bai, “Health 4.0: How Virtualization and Big Data are Revolutionizing Healthcare”, Springer, 1st ed. 2017
2. Wlater Hruby, “Digital revolution in radiology – Bridging the future of health care, second edition, Springer, New York. 2006
3. Samuel A. Fricker, Christoph Thümmler , Anastasius Gavras, “Requirements Engineering For Digital Health”, Springer, 2015

REFERENCES

1. Rick Krohn (Editor), David Metcalf, Patricia Salber, “Health-e Everything: Wearables and The Internet of Things for Health, ebook. 2013.
2. Khandpur,R.S,”Handbook of Biomedical Instrumentation ”,Second Edition. Tata Mc Graw Hill Pub. Co., Ltd. 2003
3. John, G. Webster. Medical Instrumentation: Application and Design. Second Edition. Wiley Publisher, 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
CO1	3	2	1	1	1	-	-	-	-	-	-	-	1	1
CO2	3	2	1	1	1	-	-	-	-	-	-	-	1	1
CO3	3	2	1	1	1	-	-	-	-	-	-	-	1	1
CO4	3	2	1	1	1	-	-	-	-	-	-	-	1	1
CO5	3	2	1	1	1	-	-	-	-	-	-	-	1	1
Avg	3	2	1	1	1	-	-	-	-	-	-	-	1	1

OPEN ELECTIVES

S. No.	Course Code	Course Title	Course Offering Department	Contact Periods				C
				L	T	P	Total	
1.	OAG101	Environment and Agriculture Engineering	Agri	3	0	0	3	3
2.	OAG102	Organic Farming for Sustainable Agricultural Production	Agri	3	0	0	3	3
3.	OAG103	Sustainable Development Through Indian Knowledge System	Agri	3	0	0	3	3
4.	OCE101	Air and Noise Pollution Control Engineering	Civil	3	0	0	3	3
5.	OCE102	Environmental Impact Assessment	Civil	3	0	0	3	3
6.	OCE103	Green Building Design	Civil	3	0	0	3	3
7.	OAD101	Foundation of Data Science	AIDS	3	0	0	3	3
8.	OAD102	Open Source Software Tools	AIDS	3	0	0	3	3
9.	OCS101	IoT and its Applications	CSE	3	0	0	3	3
10.	OCS102	Machine Learning with R	CSE	3	0	0	3	3
11.	OCS103	Tamil Computing	CSE	3	0	0	3	3
12.	OCY101	Cyber Forensic and Investigation	CYB	3	0	0	3	3
13.	OCY102	Social Media Security	CYB	3	0	0	3	3
14.	OEC101	Introduction to 5G Communication Networks	ECE	3	0	0	3	3
15.	OEC102	Introduction to Industrial IoT	ECE	3	0	0	3	3
16.	OEC103	Arduino Programming and its applications	ECE	3	0	0	3	3
17.	OEE101	Renewable Energy Sources	EEE	3	0	0	3	3
18.	OEE102	Energy Conservation and Management	EEE	3	0	0	3	3
19.	OEE103	Electric and Hybrid Vehicles	EEE	3	0	0	3	3
20.	OEI101	Fundamentals of Robotics	EIE	3	0	0	3	3
21.	OEI102	Sensors for Engineering Applications	EIE	3	0	0	3	3
22.	OIT101	Multimedia Technologies	IT	3	0	0	3	3
23.	OIT102	3D Printing and its Applications	IT	3	0	0	3	3
24.	OIT103	Web Frameworks	IT	3	0	0	3	3

25.	OME101	Refrigeration and Air Conditioning	MECH	3	0	0	3	3
26.	OME102	Advanced Manufacturing Processes	MECH	3	0	0	3	3
27.	OME103	Material Testing and Characterization	MECH	3	0	0	3	3
28.	OME104	Hazardous Waste Management	MECH	3	0	0	3	3
29.	OME105	Automotive Engineering	MECH	3	0	0	3	3
30.	OCH101	Nanomaterials and applications	CHE	3	0	0	3	3
31.	OPH101	Advanced Functional Materials	PHY	3	0	0	3	3

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

OAG101	ENVIRONMENT AND AGRICULTURAL ENGINEERING	L T P C 3 0 0 3

OBJECTIVES:

The course prepares the students

- 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 introduce the students about the importance of the land and water resources in India.
- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.

UNIT-I INTRODUCTION 9

Scope and importance of environmental studies. Natural resources: Renewable and renewable resources. Ecosystems: Definition, concept, structure and functions. Producers, consumers and decomposers of an ecosystem. Energy flow in the ecosystem. Types of ecosystems. Bio-diversity: Definition, classification, threats to biodiversity and its conservation,

UNIT-II ENVIRONMENTAL CONCERNS 9

Environmental pollution: Causes, effects and control of air, water, soil, thermal, noise and marine pollution. Disaster management. Floods, earthquakes, cyclones and landslides. Social issues and the environment, unsustainable to sustainable development. The Environment Protections Act, The Air Act, The water Act, The Wildlife Protection

UNIT-III CLIMATE CHANGE AND ECOLOGICAL DIVERSITY 9

Global warming and changing environment – Ecosystem changes – Changing blue green-grey water cycles – Water scarcity and water shortages – Desertification-Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insects and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology

concerns.

UNIT-IV AGRICULTURAL 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-V SUSTAINABLE AGRICULTURE 9

Sustainable agriculture-problems and its impact on agriculture, conservation agriculture strategies, HEIA, LELA and LE1SA and its techniques for sustainability, Integrated farming system components of IFS and its advantages, farming system and environment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To know how the environment and agriculture are related and the changes in the environmental due to agriculture.
2. To gather idea on about how the mechanization helps and impacts of soil erosion due to agricultural activities.
3. To gain knowledge on the need for sustainable agriculture.
4. To demonstrate how ecological balance is required for sustainability of agriculture.
5. To know the ecological diversity in agriculture and different technologies used in farming activities.

TEXTBOOKS:

1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.
3. B.K.Desai and Pujari, B.T., “Sustainable Agriculture: A vision for future”, New India Publishing Agency, New Delhi, 2007.
4. Saroja Raman, “Agricultural Sustainability – Principles, Processes and Prospects”, CRC Press, 2013.
5. Prof Johannes S. C. Wiskerke, Dr Nevin Cohen, Dr Laine Young, Prof

Alison Blay-Palmer, Achieving sustainable urban agriculture, 2020.

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 theAsia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989.
4. Sithamparanathan, J., Rengasamy, A., Arunachalam, N. “Ecosystem principles and sustainable agriculture”, Scitech Publications, Chennai, 1999.
5. Bhoopander Giri, Ram Prasad, Qiang-Sheng Wu, Ajit Varma, Biofertilizers for Sustainable Agriculture and Environment, 2019.

OAG101	PO												PSO			
	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
Average	2.0	3.0	2.0	2.0	3.0	2.0	2.0	3.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	1.0

OAG102	ORGANIC FARMING FOR SUSTAINABLE AGRICULTURAL PRODUCTION	L T P C 3 0 0 3

OBJECTIVES:

- To quantify the organic resources of integrated organic farming system (IOFS) components.
- To assess the total productivity of the system.
- To work out the economics of organic farming system.
- To gain knowledge on Organic Farming for Sustainable agriculture.
- To expose the students to the concept of Organic Farming.

UNIT – I INTRODUCTION TO ORGANIC FARMING 9

Concept of organic farming, Significance of organic farming for Indian farmers, Terminologies used in organic farming, Objectives of organic farming, Characteristics of organic farming, often debated issues in organic farming, Area under OF and size of organic food market. Status of organic farming in India.

UNIT – II SOIL HEALTH MANAGEMENT IN ORGANIC FARMING 9

Organic manures- Biofertilizers- Green manures- Crop rotation - Classification of Biofertilizers. Organic production requirements, Components. Nutrient requirements, Limiting nutrient losses, Farm Yard Manure (FYM), Enrichment of FYM.

UNIT - III MICROBIAL INOCULATIONS IN ORGANIC FARMING 9

Importance, benefits, Methods of vermicomposting, Preparation and management of vermicompost unit. Recycling of organic residues, Classification of organic residues Biofertilizers, Importance, classification and benefits of biofertilizers (Azospirillum, Azotobacter, Rhizibium, PSB, VAM etc.,)

UNIT – IV GOOD HARVESTING PRACTICES 9

Crop harvesting, signs of maturity in different field crops; physiological and crop Maturity- Methods of threshing crops, cleaning, drying and storage of field crops- Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India- Problems and prospects of rainfed agriculture in India.

UNIT – V ORGANIC REGULATION AND CERTIFICATION PROCEDURE, BRANDING, PACKAGING AND MARKETING OF ORGANIC PRODUCTS **9**

Organic Certification-process-Requirements for Organic Certification Systems in India - Basic standards for Livestock Certification - NPOP - Marketing of Organic Produce - Integrated Farming System models for Sustainable Agriculture.

TOTAL :45 PERIODS

COURSE OUTCOMES:

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

1. To the completion of the course, the students will be able to understand the concepts of Organic farming and sustainable agriculture.
2. To the Students will gain knowledge on organic farming and Overview of Organic Farming in India.
3. To the students will be able to understand Microbial Inoculations in Organic Farming.
4. To the students can design Sustainable agriculture.
5. To the students will be understand Organic Regulation and Certification Procedure.

TEXTBOOKS:

1. Dr.S.Natarajan, Dr.P.Devasenapathy, Dr.R.Kalpana, Dr.C.Sudhalakshmi, Organic farming an overview, TNAU.
2. Dilip Nandwani Organic Farming for Sustainable Agriculture, 2016.
3. Jeyabalan Sangeetha, Kasem Soytong, Devarajan Thangadurai, Abdel Rahman Mohammad Al-Tawaha,Organic Farming for Sustainable Development, 2023.
4. Mohan Chand Rajbar,Organic Farming and Livestock Management in integrated farming: An Agro-entrepreneur manual to successful Integrated farm production, 2019.
5. Gopal Chandra De. 1980., Fundamentals of agronomy. Oxford and IBH Publish

REFERENCE BOOKS:

1. Agricultural and Processed Food Products Export Development Authority (APEDA). National Programme for organic production. http://apeda.gov.in/apedawebsite/organic/Organic_Products.html
2. Singh, J.P. and N. Ravisankar.2015. Integrated Farming Systems for sustainable agricultural growth.
3. Renu Soni, Ruchitra Gupta. 2022 Organic Farming: A Sustainable Agricultural Practice, Journal of Thematic Analysis.
4. Gour, M. (2016). Organic farming in India: Status, issues and prospects. SOPAAN.
5. Santhosh kumar M., Reddy G. C., & Sangwan, P. S. (2017). A Review on Organic Farming—Sustainable Agriculture Development. International Journal of Pure and Applied Bioscience.

OAG102	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
CO1	2	-	-	-	-	3	2	-	-	2	-	1	3	-	2	-
CO2	1	3	-	2	-	2	2	2	-	-	-	3	2	3	-	2
CO3	3	-	-	2	-	-	3	-	-	2	-	1	2	3	-	-
CO4	3	2	-	-	3	2	-	-	-	-	-	3	2	-	-	3
CO5	-	-	-	2	-	-	3	3	-	-	2	-	-	2	-	3
Average	**2.0**	**3.0**	**0.0**	**2.0**	**3.0**	**2.0**	**3.0**	**3.0**	**0.0**	**2.0**	**2.0**	**2.0**	**2.0**	**3.0**	**2.0**	**3.0**

OAG103	SUSTAINABLE DEVELOPMENT THROUGH INDIAN KNOWLEDGE SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the structure and methods of ancient Indian education, focusing on holistic development through indigenous learning systems like Gurukuls, Pathshalas, and ancient universities.
- To explore how ancient Indian architecture, as seen in landmarks like the Ajanta Caves, Konark Sun Temple, and Brihadishvara Temple, embodies principles of sustainability and energy efficiency.
- To study traditional Indian farming techniques such as organic farming, rainfed Agriculture, and agroforestry to promote biodiversity and environmental stewardship.
- To understand the holistic approach of Ayurveda, focusing on the Interconnection of physical, mental, and spiritual health through individualized treatments based on one's Prakriti (constitution).
- To explore the moral responsibility humans have toward nature, focusing on the interconnectedness of life, environmental ethics, and wildlife conservation.

UNIT- I Ancient Education System in India **9**

Indigenous education systems (Home,Temples, Pathshalas, Tols, Chatuspadis and Gurukuls)-methods- multi design learning Shastra, Kala, Vidya- Prominent Universities Nalaandha and Takshashila - Vocational Training and Focus on Ethics and Values - National Logic and Reasoning, Artistic Education, Astronomy and Mathematics.

UNIT- II Vastu Shastra and Sustainable Architecture **9**

Historical Architecture Models (Ajanta Caves (Aurangabad) Brihadishvara Temple (Tanjore)Qutb Minar (Delhi)Konark Sun Temple (Odisha)Shore Temple (Mahabalipuram)-Vastu Shastra and Ancient Indian Architecture- Natural Forces (wind, water, sunlight, earth) - Energy Efficiency and Sustainable Materials - Eco-Friendly Construction- Communal Space and Architectural Carvings-Human Well-Being-Modern Integration of Vastu.

UNIT- III **Sustainable Agriculture and Water Management in Indian Knowledge Systems** **9**

Organic Farming and Rainfed Agriculture - Agroforestry and Biodiversity - Soil Science - Soil Erosion Prevention- Chemical free Farming and Environmental Stewardship- Water Management and Ancient Indian Techniques - Water Storage and Groundwater Recharge- Drought-Prone Areas and Reviving Traditional Practices-Human and Animal Powered Devices-Biodiversity Support and Ecosystem Preservation-Modern Water Scarcity Solutions and Cultural Heritage in Water Management.

UNIT- IV **Ayurveda** **9**

Ayurveda and Holistic Health-Prakriti (Individual Constitution)- Personalized Health- Locally Sourced Remedies and Seasonal Foods- Sustainable Diet and Whole, Unprocessed Foods - Herbal Medicine and Natural Remedies - Yoga, Meditation, and Pranayama - Mental and Spiritual Well-Being- Resource Efficiency and Environmental Health- Non-Synthetic Healthcare and Home Remedies- Eco-Friendly Health Practices- Modern Healthcare Integration and Sustainable Wellness.

UNIT- V **Spiritual Ecology** **9**

Moral Responsibility and Interconnectedness of Life- Cosmic Order and Ethical Living- Environmental Ethics and Wildlife Conservation- Sustainable Resource Use- Traditional Indian Festivals and Agricultural Cycle- Sustainability Movements and Ethical Responsibility- Social Equity and Spiritual Well-Being- Intergenerational Sustainability-Cultural and Environmental Preservation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Analyze the traditional learning methods, institutions, and disciplines such as Shastra, Kala, and Vidya.
2. Understand natural forces and energy efficiency in ancient Indian architecture. Explore the modern integration of Vastu principles for human well-being.
3. Understand traditional water management systems and their relevance to modern water conservation. Assess ancient Indian farming techniques and their ecological benefits

4. Understand the impact of Ayurvedic practices on environmental sustainability.
5. Understand the relationship between traditional Indian festivals and ecological balance.

TEXT BOOKS:

1. Radha Kumud Mookerji “Ancient Indian Education: Brahmanical and Buddhist”,Motilal Banarsidass Publishing House,2011
2. S. V. Ganapati Sthapati, “Building architecture of Stha-patya Veda”. Dakshinaa Pub. House. 2005.
3. R.S. Meena, “Sustainable Agriculture”, Scientific Publishers (India) January 2019.
4. Vasant Lad ,The Complete Book of Ayurvedic Home Remedies”, Little, Brown Book Group ,2 November 2006
5. Llewellyn Vaughan-Lee , “Spiritual Ecology: The Cry of the Earth", Golden Sufi Center, U.S, 24 June 2013.

REFERENCE BOOKS:

1. R. C. Majumdar, “The Concept of Education in Ancient India" by, Motilal Banarsidass. 2010.
2. Kalyan Kumar ,”Traditional Water Management Systems in India" Aryan Books International, 2007.
3. Dr María Rosa Mosquera-Losada , “Agroforestry for Sustainable Agriculture" Burleigh Dodds Science Publishing Limited ,2019
4. Dr. Ashish S. Jain , Dr. Bhushan R. Rane , Sunil R. Bakliwa Integration of Ayurvedic Herbal Medicines Into Modern Medicinal Practices, Nirali Prakashan, 2021.

OAG103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	-	3	-	-	-	-	-	2	-	-	-
CO2	1	-	-	-	-	-	-	-	1	-	-	2	-	3	1	-
CO3	-	-	-	3		1	2	-	-	-	-	-	-	2	-	2
CO4	-	-	-	-	-	-	-	1	-	-	3	-	1	-	2	-
CO5	-	-	-	-	-	1	1	3	2	-	-	2	-	-	-	-
Average	1.5	-	-	3	-	1	2	2	1.5	-	3	2	1.5	2.5	1.5	2

OCE101	AIR AND NOISE POLLUTION CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge on the principle and design of control of Indoor/ particulate/ gaseous air pollutant and its emerging trends.
- 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.
- To gain knowledge of characteristics of air pollution and noise pollution.

UNIT- I INTRODUCTION 9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution –Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards-Ambient and stack sampling and Analysis of Particulate and Gaseous Pollutants.

UNIT- II METEOROLOGY 9

Effects of Meteorology on Air pollution-Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns-Atmospheric Diffusion Theories-Dispersion models, plume rise.

UNIT- III CONTROL OF PARTICULATE CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT- IV CONTROL OF GASEOUS CONTAMINANTS 9

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

UNIT- V INDOOR AIR QUALITY MANAGEMENT 9

Air quality standards - Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness - Town planning regulations of industries- Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

- 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 equipment.
- Ability to ensure quality, control and preventive measures.

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.

OCE104	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	-	1	-	-	1	1	2	-	1	2	1	-
CO2	-	-	2	3	-	-	3	2	2	-	-	3	-	-	-	1
CO3	1	2	3	-	-	2	2	3	-	2	-	-	3	-	-	-
CO4	-	2	-	3	-	-	-	-	2	2	-	2	-	2	1	-
CO5	1	1	2	3	-	1	3	3	1	1	2	3	2	-	2	-
Average	1.0	2.0	2.0	3.0	0.0	1.0	3.0	3.0	2.0	2.0	2.0	3.0	2.0	2.0	1.0	1.0

OCE102	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop a comprehensive understanding of sustainable development concepts, the EIA process, and stakeholders' roles.
- To acquire skills in EIA procedure, baseline monitoring, and impact assessment for land, water, air, noise, and energy.
- To evaluate policy and legal aspects, and formulate effective EMPs with mitigation strategies.
- Gain proficiency in environmental auditing and review of EIA reports for clearance.
- To analyze rehabilitation plans, and explore economic aspects, including valuation and ecological economics.

UNIT- I INTRODUCTION 9

Basic concepts - Impacts of Development on Environment – Rio Principles of Sustainable Development Environmental Impact Assessment (EIA) – Historical development – EIA in project cycle – EIA Notification and Legal Framework – Stakeholders and their Role in EIA.

UNIT- II EIA METHODOLOGIES 9

LCA - EIA Procedure - Baseline monitoring - Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna – EIA Methods.

UNIT- III ENVIRONMENTAL MANAGEMENT PLAN 9

Policy and Legal Aspects of EMP - Environmental Policies and Programmes in India - Environmental Laws and Legislations - Environmental Monitoring Plan - Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna.

UNIT- IV ENVIRONMENTAL AUDITING 9

Introduction to Environmental Auditing (EnA) - General Audit Methodology - Elements of Audit Process - Waste Audits and Pollution Prevention Assessments - Auditing of EMS – EIA Report Preparation – Review of EIA Reports - Environmental Clearance.

UNIT- V ENVIRONMENTAL MITIGATIONS AND ECONOMICS 9

Rehabilitation and Resettlement Plan - National Rehabilitation and Resettlement Policy

- Economics and the Environment - Environmental Valuation - Economics of Natural Resources - Ecological Economics.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand sustainable development, articulate EIA processes, and analyze stakeholder roles.
2. Proficient in EIA procedures, baseline monitoring, and impact assessment methodologies.
3. Evaluate policies, formulate effective EMPs, and integrate mitigation strategies.
4. Master environmental auditing, ensuring compliance and sustainability through critical reviews.
5. Analyze rehabilitation plans, integrate economic principles for sustainable decision-making.

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

OCE105	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2	-	-	-	2	-	2	-	3	-	2	1	-	-	1
CO2	-	1	-	2	-	2	-	2	-	2	-	2	1	-	-	1
CO3	-	-	2	2	-	2	-	2	-	2	-	2	-	2	-	1
CO4	-	-	2	3	-	2	-	3	-	3	-	3	1	1	-	1
CO5	-	-	2	2	-	2	3	2	-	3	-	3	-	1	-	1
Average	1.0	2.0	2.0	2.0	0.0	2.0	3.0	2.0	0.0	3.0	0.0	2.0	1.0	1.0	0.0	1.0

OCE103	GREEN BUILDING DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Understand and explain the goals and principles of green buildings, including certification programs.
- To analyze the objectives of sustainable development, with a focus on evaluating the impact of energy use and carbon emissions in buildings.
- To Compare traditional building techniques and assess their impact on sustainable building practices.
- To explore the use of solar energy in buildings, considering factors like comfort and location.
- To explore green composites and sustainable approaches to water, waste, and sewage management in the built environment.

UNIT- I INTRODUCTION 9

Definitions, Goals, Principles, Features, Requirements and Benefits - Evaluation of Green Buildings - Green Rating Systems - Codes and Certification Programs - Barriers to the Propagation of Green Buildings.

UNIT- II SUSTAINABILITY AND ENERGY USE 9

Sustainability – Objectives of sustainable development – Sustainable principles - Energy use - carbon emissions – Sustainable building materials – LCA - Embodied Energy in Building Materials – Smart Materials - Transportation Energy for Building Materials - Maintenance Energy for Buildings.

UNIT- III IMPLICATIONS OF BUILDING TECHNOLOGIES 9

Traditional Efficient Building techniques - Masonry Construction and Framed Construction - Alternative building concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT- IV ENERGY SYSTEMS AND PASSIVE SOLAR DESIGN 9

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings – Thermal Comfort in Buildings – Building Physics – Daylighting strategies - Issues – Implications of Geographical Locations - Case studies.

UNIT- V GREEN COMPOSITES FOR BUILDINGS 9

Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, students will be able to:

1. Understand and apply principles of green buildings and evaluate them using certification programs.
2. Grasp sustainable development goals and propose eco-friendly solutions for energy use in buildings.
3. Compare traditional building techniques, analyze their impact, and suggest sustainable alternatives.
4. Apply knowledge of solar energy for energy-efficient building design, considering comfort and location.
5. Define and apply green composites, proposing sustainable approaches for water, waste, and sewage management.

TEXTBOOKS:

1. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
2. "Low Energy Cooling For Sustainable Buildings". John Wiley and Sons Ltd, 2009.
3. "Alternative Building Materials and Technologies" K.S.Jagadish, B. U. Venkatarama Reddy and K. S. Nanjunda Rao.. New Age International, 2007.
4. “Green Building – Guidebook for sustainable Architecture”, Dr. Michael Bauer, Peter mosle, Dr. Micheal Schwarz, Springer, 2007
5. 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.Sensing and Image Interpretation, John Wiley and Sons, Inc, New York, 1987.

OCE106	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	1	2	-	-	-	3	-	2	1	1	2	-
CO2	1	2	-	2	1	2	-	-	-	2	-	2	1	-	2	-
CO3	1	2	2	2	1	2	-	-	-	2	-	2	2	-	2	-
CO4	1	2	2	3	2	2	-	-	-	3	-	3	1	1	2	1
CO5	1	2	2	2	3	2	3	-	-	3	-	3	1	1	2	-
Average	**1.0**	**2.0**	**2.0**	**2.0**	**2.0**	**2.0**	**3.0**	**0**	**0**	**3.0**	**0**	**2.0**	**1.0**	**1.0**	**2.0**	**1.0**

OAD101 **FOUNDATION OF DATA SCIENCE** **L T P C**

3 0 0 3

OBJECTIVES:

- Familiarize students with the data science process.
- Understand the data manipulation functions in Numpy and Pandas.
- Explore different types of machine learning approaches.
- Understand and practice visualization techniques using tools.
- Learn to handle large volumes of data with case studies.

UNIT-I: INTRODUCTION **9**

Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data.

UNIT-II: DATA MANIPULATION **9**

Python Shell - Jupyter Notebook - IPython Magic Commands - NumPy Arrays- Universal Functions – Aggregations – Computation on Arrays – Fancy Indexing – Sorting arrays – Structured data – Data manipulation with Pandas – Data Indexing and Selection – Handling missing data – Hierarchical indexing – Combining datasets – Aggregation and Grouping – String operations – Working with time series – High performance.

UNIT-III: MACHINE LEARNING **9**

The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning- Classification, regression - Clustering – Outliers and Outlier Analysis .

UNIT- IV DATA VISUALIZATION **9**

Importing Matplotlib – Simple line plots – Simple scatter plots – visualizing errors – density and contour plots – Histograms – legends – colors – subplots – text and annotation – customization – three dimensional plotting - Geographic Data with Basemap - Visualization with Seaborn.

UNIT -V HANDLING LARGE DATA 9

Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Gain knowledge on data science process.
2. Perform data manipulation functions using Numpy and Pandas.
3. Understand different types of machine learning approaches.
4. Perform data visualization using tools.
5. Handle large volumes of data in practical scenarios.

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016.

REFERENCES:

1. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017.
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green Tea Press, 2014

CO – PO – PSO Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	2	3	2	-	-	-	3	1	3	2	-	-	-	-
2	2	2	2	3	3	-	-	-	2	2	3	2	-	-	-	-
3	3	3	3	3	2	-	-	-	2	3	1	1	-	-	-	-
4	2	3	2	3	2	-	-	-	3	3	3	3	-	-	-	-
5	2	3	2	2	3	-	-	-	3	3	1	3	-	-	-	-
Avg	**2.4**	**2.8**	**1.3**	**2.8**	**2.4**	**-**	**-**	**-**	**2.6**	**2.4**	**2.2**	**2.2**	-	-	-	-

OAD102 **OPEN SOURCE SOFTWARE TOOLS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the basic concepts of open source software.
- To understand about open source databases.
- To understand about the open source programming languages.
- To understand and apply the concepts in python language.
- To understand the real world problems using case studies.

UNIT-I: INTRODUCTION **9**

Introduction to Open sources – Need of Open Sources – Advantages of Open Sources–Application of Open Sources. Open source operating systems: LINUX: Introduction –General Overview – Kernel Mode and user mode – Process – Advanced Concepts –Scheduling – Personalities – Cloning – Signals – Development with Linux.

UNIT-II: OPEN SOURCE DATABASE **9**

MySQL: Introduction – Setting up account – Starting, terminating and writing your ownSQL programs – Record selection Technology – Working with strings – Date and Time– Sorting Query Results – Generating Summary – Working with metadata – Usingsequences – MySQL and Web.

UNIT-III: OPEN SOURCE PROGRAMMING LANGUAGES **9**

PHP: Introduction – Programming in web environment – variables – constants – data;types – operators – Statements – Functions – Arrays – OOP – String Manipulation and regular expression – File handling and data storage – PHP and SQL database – PHP and LDAP – PHP Connectivity – Sending and receiving E-mails – Debugging and error handling – Security – Templates.

UNIT-IV: PYTHON **9**

Syntax and Style – Python Objects – Numbers – Sequences – Strings – Lists and Tuples – Dictionaries – Conditionals and Loops – Files – Input and Output – Errors and Exceptions – Functions – Modules – Classes and OOP – Execution

Environment.

UNIT-V: CASE STUDIES 9

Apache, BSD, Linux, Mozilla (Firefox), Wikipedia, Joomla, GCC, Open Office.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the basic concepts of open source softwares.
- Excel in open source databases.
- Understand about open source programming languages.
- Apply the concepts using python.
- Understand the real world problems using the case studies.

TEXT BOOKS:

1. Remy Card, Eric Dumas and Frank Mevel, “The Linux Kernel Book”, Wiley Publications, 2003.
2. Steve Suchring, “MySQL Bible”, John Wiley, 2002 .
3. Kailash Vadera, Bhavyesh Gandhi, “Open Source Technology”, Laxmi Publications Pvt Ltd 2012, 1st Edition.

REFERENCES:

1. Rasmus Lerdorf and Levin Tatroe, “Programming PHP”, O’Reilly, 2002
2. Wesley J. Chun, “Core Phython Programming”, Prentice Hall, 2001
3. Martin C. Brown, “Perl: The Complete Reference”, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
4. Steven Holzner, “PHP: The Complete Reference”, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
5. Vikram Vaswani, “MYSQL: The Complete Reference”, 2nd Edition, Tata McGraw- Hill Publishing Company Limited, Indian Reprint 2009.
6. Fadi P. Deek and James A. M. McHugh, “Open Source: Technology and Policy”, Cambridge Universities Press 2007.

CO – PO – PSO Mapping

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

OCS101 **IoT AND ITS APPLICATIONS** **L T P C**

3 0 0 3

OBJECTIVES:

- To study the fundamentals about IoT
- To study about IoT Access technologies
- To study the design methodology and different IoT hardware platforms.
- To study the basics of IoT Data Analytics and supporting services.
- To study about various IoT case studies and industrial applications.

UNIT- I: FUNDAMENTALS OF IoT **9**

Evolution of Internet of Things, Enabling Technologies, M2M Communication, IoT World Forum (IoTWF) standardized architecture, Simplified IoT Architecture, Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.

UNIT- II: IoT PROTOCOLS **9**

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks,6LoWPAN, Application Transport Methods: SCADA, Application Layer Protocols: CoAP and MQTT.

UNIT- III: DESIGN AND DEVELOPMENT **9**

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details

UNIT- IV: DATA ANALYTICS AND SUPPORTING SERVICES **9**

Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M, Supporting Services: Computing Using a Cloud Platform for IoT/M2M Applications/Services, Everything as a service and Cloud Service Models.

UNIT- V: CASE STUDIES/INDUSTRIAL APPLICATIONS 9

IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments, Industry 4.0 concepts.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand the basics of IoT.
2. Implement the state of the Architecture of an IoT
3. Understand design methodology and hardware platforms involved in IoT.
4. Understand how to analyze and organize the data.
5. Compare IOT Applications in Industrial & realworld.

TEXT BOOKS:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017(unit 1,2,3,)
2. Internet of Things - A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015 (unit 5)
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education(unit 4)

REFERENCES:

1. The Internet of Things - Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit2).
2. “From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence”,Jan Ho¨ ller, VlasiosTsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014.
3. Architecting the Internet of Things,Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer,2011.
4. Recipes to Begin, Expand, and Enhance Your Projects, 2nd Edition, Michael Margolis, Arduino Cookbook and O"Reilly Media,2011.

CO – PO – PSO Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	3	3	3	2				2			1	2	-	-	-
2	3	3	3	3									-	2	-	-
3	3	3	3		3		2	1		2			-	-	1	-
4	3	3	3	3	3						2		-	-	2	-
5	3	3	3	3	2	3	2			3	2	1	-	2	-	2
Avg	**3**	**3**	**3**	**3**	**2.5**	**3**	**2**	**1**		**2.5**	**2**	**1**	**2**	**2**	**1.5**	**2**

OCS102 **MACHINE LEARNING WITH R** **L T P C**

3 0 0 3

OUTCOMES:

- To understand the mechanics of operation and characteristics of linear model of machine learning
- Use R to implement methods for training and model selection ‘
- Acquire Knowledge in various learning techniques like decision tree, Analytical, Inductive and Reinforced learning.
- Identify and apply the appropriate machine learning techniques for classification, Pattern recognition, optimization and decision problems.
- Development of techniques in information science applications by applying Computational intelligence and appropriate machine learning techniques.

UNIT- I: INTRODUCTION **9**

Machine learning -Examples of Machine Learning applications-Learning Associations- Classification-Regression-Unsupervised Learning-Reinforcement Learning-Supervised learning: Learning a class from Examples-Regression-Model Selection and Generalization. Case Study: Familiarity with R tool and Python programming language and libraries

UNIT-II: CONCEPT LEARNING AND DECISION-TREE LEARNING **9**

Concept Learning - Concept learning Task - Concept Learning as search -Finding a maximally specific hypothesis - Version Spaces and Candidate elimination Algorithm -Inductive Bias Decision Tree Learning - Decision Tree representation - Problems for Decision Tree Learning - Hypothesis Search space - Inductive Bias in Decision Tree Learning - Issues in Decision Tree Learning.Case Study: Implementation of decision tree algorithm for problems in Retail Domain.

UNIT-III: MULTILAYER PERCEPTRONS AND DEEP LEARNING **9**

The Perceptron-Training a Perceptron-Learning Boolean Functions-Multilayer Perceptrons- MLP as Universal Approximator Back propagation Algorithm-Training Procedures Convolution Networks -The Convolution Operation-Pooling-Convolution and Pooling as an infinitely strong prior -Variants of the Basic Convolution Function -Structured Outputs -Data Types -Efficient Convolution

Algorithms -Random and Unsupervised features.Case Study: Implementation of Back propagation algorithm for problems in financial domain.

UNIT-IV: CLUSTERING 9

Similarity-Based Clustering-Unsupervised learning problems-Hierarchical Agglomerative Clustering (HAC)-Single-link, completelink, group-average similarity- k-Means and Mixtures of Gaussians-Flat clusteringk-Means algorithms-Mixture of Gaussian modelEM-algorithm for mixture of Gaussian model. CaseStudy: Implementation of clustering algorithm for problems in financial/insurance/health care domain.

UNIT-V: REINFORCEMENT LEARNING 9

Introduction - learning task - Q learning - The Q function - Algorithm for Q learning -convergence- experimentation strategies - updating sequence -Non deterministic rewards and actions - Temporal difference learning -Generalizing from examples - relationship to dynamic programming Case Study: Implementation of Q learning algorithm/reinforcement learning for problems in automotive domain/games

TOTAL : 45 PERIODS

OUTCOMES:

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

1. Understand the basics ideas and objective of machine learning
2. Understand the problem of over fitting in machine learning.
3. Transfer concrete problems to machine learning problems and select appropriate models to solve them.
4. Understand how to analyze and organize the data using clustering methods.
5. Understand reinforcement learning algorithms and experiment strategies.

TEXT BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press, September 2014, ISBN 978-0-262-02818-9.(Units 1,3(Multilayer Perceptrons) & 4)
2. Mitchell, Tom, "Machine Learning", New York, McGraw-Hill, First Edition, 2003. (Units 2,5)

REFERENCES:

1. Ian GoodFellow,Yoshua Bengio,Aaron Courville ,"Deep Learning",MIT Press Book (Unit 3 - Convolutional Networks),Nov. 2016
2. Stephen Marshland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC 2009.
3. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", MIT Press (MA) 2012.

CO – PO – PSO Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	-	1	1	-	1	-	-	1	-	-	1	-
2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	1	-
3	2	1	1	-	-	-	1	-	1	1	-	1	-	-	2	-
4	1	1	2	1	-	-	1	-	1	1	1	1	-	1	2	-
5	1	1	1	1	-	-	-	1	1	1	-	-	1	1	2	2
Avg	**1.2**	**1**	**1.3**	**1**	**1**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**1**	**1**	**1.6**	**2**

OCS103 **TAMIL COMPUTING** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the Tamil grammar and programming basics for Tamil computing.
- To understand the various types of Tamil Computing applications.
- To make the students understand the use of Tamil computing tools and Resources.
- To strengthen the students' ability to carry out the Computational Linguistics in Tamil computing.
- To understand the concepts of Tamil text processing using open – Tamil python library.

UNIT-I: TAMIL GRAMMAR **9**

Introduction to Computational Linguistics-Grammars-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: COMPUTATIONALLINGUISTICS **9**

Basic linguistics - Phonology - Phonology computing - lexicography - syntax - semantics - pragmatics- Regular languages-and their limitations-Finite-state automata.

UNIT-IV: TAMIL COMPUTING TOOLS & RESOURCES **9**

POS Tagger - Morphological Analyser - Morphological Generator - Sentence Parser - Named Entity Recognizer - Word Sense Disambiguator - Ontologies.

UNIT-V: TAMILCOMPUTINGAPPLICATIONS 9

Machine Translation -Information retrieval & Extraction - Question Answering - Text Summarization- Automatic Indexing - Text Mining - Conceptual Search.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Explain classification of Tamil grammar and properties
2. Adopt a suitable process for tamil computing tools.
3. Analyze the different types of computational linguistics such as phonology, Morphology, lexicography.
4. Perform and analyze the Tamil computing applications.
5. Analyze and process the Tamil python library.

TEXT BOOKS:

1. The Oxford Handbook of Computational Linguistics, Edited by RuslanMitkov, Oxford University Press, 2014.
2. Tamil Computing ,Dr.R.Ponnusamy, Allied Publishers private limited, 2024.

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. J.E.Hopcroft, R.Motwani and J.D Ullman, - Introduction to Automata Theory, Languages and Computations, ThirdEdition, Pearson Education, 2013.
4. Natural language processing and computational linguistics, Bhargav SrinivasaDesikan Packt Publishing, first edition 2018.
5. The Phonology and morphology of tamil chrisdas Prathima, 2016.
6. Pos Tasser R Morphological Analzser Shodhganga inflibnet.ac.in

CO- PO - PSO Mapping

CO	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	-	-	-	1	1	-	1	-	-	1	-	-	1	-
2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	1	-
3	2	1	1	-	-	-	1	-	1	1	-	1	-	-	2	-
4	1	1	2	1	-	-	1	-	1	1	1	1	-	1	2	-
5	1	1	1	1	-	-	-	1	1	1	-	-	1	1	2	2
Avg	**1.2**	**1**	**1.3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1.6**	**2**

OCY101 CYBER FORENSIC AND INVESTIGATION LT P C

3 0 0 3

OBJECTIVES:

- Principles of digital evidence handling and forensic investigation techniques.
- Proficiency in using forensic tools for imaging, data recovery, and analysis.
- Understanding legal and ethical considerations in cyber investigations.
- Incident response planning and execution for cyber incidents.
- Documentation and reporting of forensic findings for stakeholders and legal purposes.

UNIT – I : INTRODUCTION TO CYBER FORENSICS 9

Computer Forensics Fundamentals – Types of Computer Forensics Technology – Types of Computer Forensics Systems – Vendor and Computer Forensics Services.

UNIT – II : COMPUTER FORENSICS EVIDENCE AND CAPTURE 9

Data Recovery – Evidence Collection and Data SeizurE-Duplication and Preservation of Digital Evidence-Computer Image Verification and Authentication.

UNIT – III : COMPUTER FORENSIC ANALYSIS 9

Discover of Electronic EvidencE- Identification of Data – Reconstructing Past Events – Fighting against Macro Threats – Information Warfare Arsenal – Tactics of theMilitary – Tactics of Terrorist and Rogues – Tactics of Private Companies.

UNIT – IV : INVESTIGATION 9

Arsenal – Surveillance Tools – Hackers and Theft of Components – Contemporary Computer Crime- Identity Theft and Identity Fraud – Organized Crime &Terrorism – Avenues Prosecution and Government Efforts – Applying the First Amendment to Computer Related Crime-The Fourth Amendment and other Legal Issues.

UNIT – V : COMPUTER FORENSIC INVESTIGATION CASES 9

Developing Forensic Capabilities – Searching and Seizing Computer Related

Evidence –Processing Evidence and Report Preparation – Future Issues.

TOTAL : 45 PERIODS

OUTCOMES:

- To demonstrate proficiency in using forensic tools and techniques for digital evidence analysis.
- To critically evaluate and interpret digital artifacts to reconstruct cyber incident timelines.
- To apply legal and ethical principles to ensure compliance in cyber forensic investigations.
- To formulate and implement incident response strategies to mitigate cyber threats effectively.
- To prepare clear and comprehensive forensic reports and presentations for stakeholders.

TEXT BOOKS:

1. John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation”, CengageLearning, 2nd Edition, 2005. (CHAPTERS 1 – 18). (UNIT I – IV)
2. Marjie T Britz, “Computer Forensics and Cyber Crime: An Introduction”, Pearson Education, 2nd Edition, 2008. (CHAPTERS 3 – 13). (UNIT IV – V)

REFERENCES:

1. MariE-Helen Maras, “Computer Forensics: Cybercriminals, Laws, and Evidence”, Jones &Bartlett Learning; 2nd Edition, 2014.
2. Chad Steel, “Windows Forensics”, Wiley, 1st Edition, 2006.
3. Majid Yar, “Cybercrime and Society”, SAGE Publications Ltd, Hardcover,2nd Edition, 2013.
4. Robert M Slade, “Software Forensics: Collecting Evidence from the Scene of a DigitalCrime”, Tata McGraw Hill, Paperback, 1st Edition, 2004.

CO – PO – PSO Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
2	-	3	-	3	-		-	-	-	-	-	-	-	2	-	-
3	3	-	2		-	3	-	-	-	-	-	-	-	-	3	-
4	2	-	2		-	-	-	-	-	-	-	-	-	2		-
5	3	-	-	2	-	2	-	-	-	-	-	-	-	-	2	-
Avg	**2.7**	**2.5**	**2**	**2.5**	**-**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**2.5**	**-**

OCY102 SOCIAL MEDIA SECURITY L T P C

3 0 0 3

OBJECTIVES:

- To Understand Social Media Platforms: Learn how popular social media platforms work.
- To Identify Security Risks: Recognize threats and vulnerabilities on social media.
- To Privacy and Data Protection: Protect personal information on social media.
- To Legal and Ethical Issues: Understand legal and ethical issues in social media.
- To Security Best Practices: Apply methods to secure social media accounts.

UNIT-I: INTRODUCTION TO SOCIAL MEDIA SECURITY 9

Social Media Platforms-Communication Impact-Cybersecurity Basics-Security Threats-User Awareness-Breach Case Studies-Data Collection-Security Features-Future Trends.

Unit-II: PRIVACY AND ACCOUNT SECURITY 9

Privacy Settings-Strong Passwords-Two-Factor Authentication (2FA)-Geotagging Risks Personal Information- Third-Party Apps-Account Takeover-Encryption Role-Safe Posting.

UNIT-III: THREATS AND ATTACKS 9

Social Engineering-Cybercriminal Tactics-Suspicious Activity-Malware Links-Hacking Cases-Suspicious Content-Security Tests-Insider Threats-Threat Intelligence.

UNIT-IV: LEGAL AND ETHICAL ISSUES 9

International Laws-Intellectual Property-Privacy Policies-Ethical Data Use-User Responsibilities-Legal Disputes- Freedom of Speech-Compliance Requirements-RegulationFuture.

UNIT-V: ONLINE REPUTATION AND POLICIES9

Reputation Strategies-Brand Impact-Crisis Management-Corporate Communication-SocialMedia Policies- Governance Role-Monitoring Tools-Employee

Training-Cybersecurity Integration.

TOTAL: 45 PERIODS

OUTCOMES:

1. To Understand Social Media Platforms.
2. To Identify Security Threats.
3. To Protect Privacy and Apply best practices to protect personal information on social media.
4. To Address Legal and Ethical Issues.

TEXT BOOKS:

1. "Social Media Security: Leveraging Social Networking While Mitigating Risk" by Michael Cross.
2. "The Social Media Handbook: Rules, Policies, and Best Practices to Successfully ManageYour Organization's Social Media Presence, Posts, and Potential Legal Issues" by Nancy Flynn.

REFERENCES:

1. "Phishing Dark Waters: The Offensive and Defensive Sides of Malicious Emails" byChristopher Hadnagy and Michele Fincher.
2. The Ethical Hack: A Framework for Business Value Penetration Testing" by James S. Tiller.

CO – PO and PSO MAPPING

COs	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	-	3	-	-	-	-	-	-	-	-	3	-	2	-
2	-	1	-	2	-	-	-	-	-	-	-	-	3	-	1	-
3	-	-	1	2	3	-	-	-	-	-	-	-	3	-	1	-
4	-	1	-	2	-	-	-	-	-	-	-	-	3	-	2	-
5	1	1	-	2	2	-	-	-	-	-	-	-	3	1	2	-
Avg	**1**	**1.2**	**1**	**2.2**	**2.5**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**1**	**1.6**	**-**

OEC101	INTRODUCTION TO 5G COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the evolution of wireless networks.
- To learn the various features of 5G.
- To get acquainted with the fundamentals of EPC.
- To study the processes associated with 5G architecture.
- To explore the spectrum sharing and spectrum trading.
- To assess the security features in 5G networks.

UNIT-I: EVOLUTION OF WIRELESS NETWORKS 9

Networks evolution: 1G, 2G, 3G, 4G, Evolution of radio access networks, Need for 5G. 4G versus 5G, Next Generation Core (NG-Core), visualized Evolved Packet Core (vEPC).

UNIT-II: 5G CONCEPTS AND CHALLENGES 9

Fundamentals of 5G technologies, Overview of 5G core network architecture,5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT-III: NETWORK ARCHITECTURE AND THE PROCESSES 9

5G architecture and core, Network slicing, Multi access edge computing (MEC) Visualization of 5G components, End-to-end system architecture, Service continuity, Relation to EPC, and Edge computing.

UNIT-IV: PROTOCOLS AND SPECTRUM MANAGEMENT 9

5G protocols: 5G NAS, NGAP, GTP-U, IP Sec and GRE, Mobility management, Command and control, Spectrum sharing and Spectrum trading, Cognitive radio based on 5G.

UNIT-V: SECURITY IN 5G NETWORKS 9

Security features in 5G networks, Network domain security, User domain security, Flow based QoS framework, Mitigating the threats in 5G.

TOTAL : 45 Periods

COURSE OUTCOMES:

- Emphasize the basic theory of evolution of communication techniques
- Apply the concepts of 4G communication
- Assess the need for 5G communication Techniques
- Comprehend architecture and protocols for 5G communication
- Understand the principles of dynamic spectrum management
- Analyze the security aspects in 5G networks

TEXT BOOKS:

3. 5G Core networks: Powering Digitalization, Stephen Rommer, Academic Press, 2019.
4. An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases, Saro Velrajan, First Edition, 2020.

REFERENCES:

10. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen, Copyrighted Material

11. 5G system Design: An end to end Perspective , Wan Lee Anthony, Springer Publications,2019

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
OEC101.1	3	3	2	2	-	2	-	-	-	-	-	3	2	2
OEC101.2	3	3	3	2	-	2	-	-	-	-	-	2	2	-
OEC101.3	3	3	3	2	-	2	-	-	-	-	-	2	2	-
OEC101.4	3	3	3	2	-	2	-	-	-	-	-	2	2	-
OEC101.5	3	3	3	2	-	2	-	-	-	-	-	2	2	-
OEC101.6	3	2	3	2	-	2	-	-	-	-	-	2	2	2
AVG	3	3	3	2	-	2	-	-	-	-	-	2	2	2

OEC102	INTRODUCTION TO INDUSTRIAL IoT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand basic industrial processes and its reference architecture
- To perceive the knowledge of networks and programming of IIOT.
- To study the role of sensors, actuators and communication protocols used for interfacing.
- To introduce and familiarize the industry 4.0
- To master security in IIOT
- To study application of IIOT in various fields

UNIT-I: INTRODUCTION TO INDUSTRIAL IoT AND ITS ARCHITECTURE **9**

IIoT Introduction, Industrial Internet Architecture Framework – Functional Viewpoint – Operational Domain, Information Domain, Application Domain, Business Domain – Implementation View point – Architectural Topology – Three Tier Topology – Data Management.

UNIT-II: NETWORKING AND PROGRAMMING OF IIoT **9**

Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication. Industrial IoT- Layers: IIoT Communication, IIoT Networking. Industrial IoT: IIoT Analytics - Introduction, Machine Learning and Data Science, R and Julia Programming, Data Management with Hadoop.

UNIT-III: SENSOR AND INTERFACING **9**

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet, Current, and M2M.

UNIT-IV: COMPUTATION IN IIoT AND SECURITY 9

SDN in IIoT, Data Center Networks, Industrial IoT: Security and Fog Computing- Cloud Computing in IIoT, Industrial IoT Application Domains: Factories and Assembly Line, Food Industry.

UNIT-V: IIoT APPLICATIONS 9

Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security: AR and VR safety applications, Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Interpret basic industrial processes and its reference architecture
- Comprehend to the modern networking technologies and programming of IIOT.
- Illustrate the sensors, actuators and communication protocols used for interfacing.
- Analyze the concepts and gain insights into Industry 4.0
- Handle real time security issues in IIOT.
- Realize the importance of IIoT applications in real time.
- Create numerous IOT applications with the physical world of humans and real life problem solving.

TEXT BOOKS:

1. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.2020

2. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2017
3. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B.Rawart(Springer)
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

REFERENCES:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
2. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
3. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key, applications and Protocols", Wiley, 2012
4. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC504.1	1	-	1	-	-	-	-	-	-	-	-	3	1	2
PEC504.2	1	-	1	-	-	-	-	-	-	-	-	2	2	2
PEC504.3	2	3	3	3	-	-	-	-	-	-	-	2	2	3
PEC504.4	1	-	2	-	-	-	-	-	-	-	-	2	2	2
PEC504.5	2	1	3	2	-	-	-	-	-	-	-	2	3	2
PEC504.6	2	3	3	2	-	-	-	-	-	-	-	2	3	2
AVG	2	3	3	2	-	-	-	-	-	-	-	2	2	2

OEC103	ARDUINO PROGRAMMING AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the evolution of IoT boards
- To program Arduino to control lights, motors and other devices
- To learn Arduino's architecture, including inputs and connectors for add-on devices.
- To add third-party components such as LCDs, accelerometers, gyroscopes, and GPS trackers to extend Arduino's functionality.
- To explore various options in programming Arduino boards
- To test, debug, and deploy the Arduino to solve real world problems

UNIT-I: INTRODUCTION TO SENSORS 9

Transducers, Classification, Roles of sensors in IoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IOT sensors, Role of actuators, types of actuators.

UNIT-II: ARDUINO GPIOs and APIs 9

Hardware requirement for Arduino, Connecting remotely over the network using VNC, GPIO Basics, Controlling GPIO Outputs Using a Web Interface, APIs / Packages- Quark SOC processor.

UNIT-III: ARDUINO INTERFACES 9

Sensor with Arduino- Humidity, Proximity, IR Motion, Accelerometer, Sound, Light Distance, Pressure, Thermal - Reading various sensor data on serial monitor and LCD Display.

UNIT-IV: PROGRAMMING IN ARDUINO IoT DEVICE 9

Preparing the development environment (Arduino IDE), Exploring the Arduino language syntax, Coding, compiling, and uploading to the microcontroller, Working with Arduino Communication Modules: Bluetooth Modules, Wi-Fi Modules and I2C and SPI.

UNIT-V: PROGRAMMING ESP 8266 MODULE 9

ESP8266 Wi-Fi Serial Module: Overview, Setting Up the Hardware, Interfacing with Arduino, Creating an IoT Temperature and Humidity Sensor System, Overview of DHT-22 Sensor, Interfacing the Hardware: Arduino, ESP8266 WiFi Module, and DHT-22 Sensor, Checking Your Data via Thing Speak.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the basics of sensors, its functioning.
- Execute basic and advanced assembly language programs.
- Learn the ways to interface I/O devices with processor for task sharing.
- Evoke the basics of co-processor and its ways to handle float values by its instruction set.
- Recognize the functionality of micro controller, latest version processors and its applications.
- Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyse the results.

TEXT BOOKS:

1. Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, 2nd Edition, McGraw-Hill Education, 2017.
2. Donald Norris, The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black, 1 st edition,McGraw Hill Education, 2015

REFERENCES:

1. Marco Schwartz, Home Automation with Arduino, 3rd edition, Open Home Automation 2014.
2. Schwartz, Marco. Internet of things with arduino cookbook, 1st edition, Packt Publishing Ltd, 2016.

3. Kooijman, Matthijs. Building Wireless Sensor Networks Using Arduino, 1st edition, Packt Publishing Ltd, 2015

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
OEC103.1	3	3	2	2	-	-	-	-	-	-	-	3	2	2
OEC103.2	3	3	3	2	-	-	-	-	-	-	-	2	2	-
OEC103.3	3	3	3	2	-	-	-	-	-	-	-	2	2	-
OEC103.4	3	3	3	2	-	-	-	-	-	-	-	2	2	-
OEC103.5	3	3	3	2	-	-	-	-	-	-	-	2	2	-
OEC103.6	3	2	3	2	-	-	-	-	-	-	-	2	2	2
AVG	3	3	3	2	-	-	-	-	-	-	-	2	2	2

OEE101 RENEWABLE ENERGY SOURCES L T P C

3 0 0 3

COURSE OBJECTIVES:

- To know the Indian and global energy scenario.
- To learn the various solar energy technologies and its applications.
- To educate the various wind energy technologies.
- To explore the various bio-energy technologies.
- To study the ocean and geothermal technologies.

UNIT-I: ENERGY SCENARIO 9

Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status-Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans.

UNIT -II: SOLAR ENERGY 9

Solar radiation – Measurements of solar radiation and sunshine – Solar spectrum - Solar thermal collectors – Flat plate and concentrating collectors – Solar thermal applications – Solar thermal energy storage – Fundamentals of solar photo voltaic conversion – Solar cells – Solar PV Systems – Solar PV applications.

UNIT -III: WIND ENERGY 9

Wind data and energy estimation – Betz limit - Site selection for windfarms – characteristics – Wind resource assessment - Horizontal axis wind turbine – components - Vertical axis wind turbine – Wind turbine generators and its performance – Hybrid systems – Environmental issues - Applications.

UNIT -IV: BIO-ENERGY 9

Bio resources – Biomass direct combustion – thermochemical conversion – biochemical conversion-mechanical conversion - Biomass gasifier - Types of biomass gasifiers – Cogeneration – Carbonization – Pyrolysis - Biogas plants – Digesters – Biodiesel production – Ethanol production - Applications.

UNIT -V: OCEAN AND GEOTHERMAL ENERGY 9

Small hydro - Tidal energy – Wave energy – Open and closed OTEC Cycles – Limitations – Geothermal energy – Geothermal energy sources - Types of geothermal power plants – Applications - Environmental impact.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Discuss the Indian and global energy scenario.
CO2: Describe the various solar energy technologies and its applications.
CO3: Explain the various wind energy technologies.
CO4: Explore the various bio-energy technologies.
CO5: Discuss the ocean and geothermal technologies.

TEXT BOOKS:

1. Fundamentals and Applications of Renewable Energy | Indian Edition, by Mehmet Kanoglu, Yunus A. Cengel, John M. Cimbala, cGraw Hill; First edition (10 December 2020), ISBN-10 :9390385636.
2. Renewable Energy Sources and Emerging Technologies, by Kothari, Prentice Hall India Learning Private Limited; 2nd edition (1 January 2011), ISBN-10: 8120344707.

REFERENCES:

1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 2012.
2. Rai.G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2014.
3. Sukhatme.S.P., “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2009.
4. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Alpha Science Intl Ltd, 2015.
5. Twidell, J.W. & Weir A., “Renewable Energy Resources”, EFNSpon Ltd., UK, 2015.

CO - PO and CO - PSO MAPPING

OEE101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2			1							3			
CO2	3	3	2			1							3			
CO3	3	3	2			1							3			
CO4	3	3	2			1							3			
CO5	3	3	2			1							3			
Average	**3**	**3**	**2**			**1**							**3**			

OEE102 ENERGY CONSERVATION AND MANAGEMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

At the end of the course, the student is expected to

- Acquire knowledge in the field of energy conservation and management.
- Study the various measures for energy conservation in electrical devices both static & rotating machineries
- Analyze the energy efficiency in thermal utilities
- Know the concept of compressed air system and improve the efficiency.
- Understand and analyze 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 conservation and its importance - need for energy management – Energy accounting -Energy monitoring, targeting and reporting- Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers.

UNIT -II: ELECTRICAL SYSTEMS 9

Electrical load management and maximum demand control - power factor improvement and its benefit - selection and location of capacitors - performance assessment of PF capacitors automatic power factor controllers - transformer losses - Electric motors: motor efficiency - factors affecting motor performance - energy saving opportunities with energy efficient motors – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination. Lighting System: Light source, choice of lighting, luminance requirements – ballast - energy efficient lighting controls - energy conservation avenues

UNIT -III: THERMAL SYSTEMS 9

Introduction to fuels- Boilers: Types, combustion in boilers, performances evaluation, analysis of losses - energy conservation opportunities - FBC boilers - Steam System:

Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings - Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control,draft control, waste heat recovery – Refractory : types, selection and application of refractories, heat loss .

UNIT -IV: COMPRESSED AIR SYSTEM 9

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems –Cooling Towers – Diesel Generating System - methods adopted for effecting ENCON – economics of ENCON adoption in all the utilities.

UNIT -V: ECONOMICS 9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Acquire knowledge in the field of energy conservation and management process.

CO2: Learn the various measures for energy conservation in electrical devices.

CO3: Design the effective thermal utility system.

CO4: Improve the efficiency in compressed air system.

CO5: Suggest methodologies for Energy Economics.

TEXT BOOKS:

1. Mehmet Kanoğlu, Yunus A. Çengel, 'Energy Efficiency and Management for Engineers', 1st Edition, McGraw-Hill Education, 2020.
2. D Moncef Krati, "Energy Audit of Building Systems: An Engineering Approach", Second Edition, CRC Press, 2016.
3. Sonal Desai, 'Handbook of Energy Audit', McGraw Hill Education (India) Private Limited,2015

REFERENCES:

1. Michael P.Deru, Jim Kelsey, 'Procedures for Commercial Building Energy Audits',American Society of Heating, Refrigerating and Air conditioning Engineers, 2011.
2. Charles M. Gottschalk, 'Industrial Energy Conservation', Wiley, 1996.

CO - PO and CO - PSO MAPPING

PPS403	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1		1		3				2			1			
CO2			2		1				2			1	1	2		
CO3		1		3		2							1			
CO4	3					3		2			2		1			
CO5		2		3	2		1	2				2	2			
Average	**2**	**1.33**	**2**	**2.33**	**1.5**	**2.66**	**1**	**2**	**2**	**2**	**2**	**1.5**	**1.2**	**2**		

OEE103 ELECTRIC AND HYBRID VEHICLES L T P C

3 0 0 3

COURSE OBJECTIVES:

- To know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures.
- To acquire the knowledge on modelling, sizing of batteries.
- To understand the working principle, construction and characteristics of various motors.
- To provide knowledge about various power converters and control.
- To understand the Hybrid and Electric vehicles.

UNIT-I: DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES 9

Need for Electric vehicle- Comparative study of diesel, petrol, hybrid and electric Vehicles. Advantages and Limitations of hybrid and electric Vehicles. - Design requirement for electric vehicles- Range, maximum velocity, acceleration, power requirement, mass of the vehicle. Various Resistance- Transmission efficiency-. History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles.

UNIT -II: ENERGY SOURCES 9

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

UNIT -III: MOTORS AND DRIVES 9

Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT -IV: POWER CONVERTERS AND CONTROLLERS 9

Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes.

UNIT -V: HYBRID AND ELECTRIC VEHICLES 9

Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles – Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the operation and architecture of electric and hybrid vehicles.

CO2: Identify various energy source options like battery and fuel cell.

CO3: Select suitable electric motor for applications in hybrid and electric vehicles.

CO4: Explain the role of power electronics in hybrid and electric vehicles

CO5: Analyze the energy and design requirement for hybrid and electric vehicles.

TEXT BOOKS:

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

REFERENCES:

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

CO - PO and CO - PSO MAPPING

OEE103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	2	3	2					1	1	2		2	
CO2	3	3	3	2	3	2						1		1		1
CO3	3	3	3	2	3	2	3					2	2			1
CO4	3	3	3	2	3	2					1	1				
CO5	3	3	3	2	3	2	2				1	1	1			
Average	3	3	3	2	3	2	2.5				1	1.2	1.6	1	2	1

OEI101	FUNDAMENTALS OF ROBOTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- 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 INTRODUCTION TO ROBOTICS 9

Robot - Definition - Robot Anatomy - Coordinate 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 DRIVE SYSTEMS AND GRIPPERS 9

Pneumatic Drives-Hydraulic Drives-Electrical Drives- Fundamental features and Applications of A.C & D.C. Servo Motors, Stepper Motors, Grippers-Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Selection and Design Considerations

UNIT-III SENSORS FOR ROBOT 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.

UNIT-IV KINEMATICS AND PROGRAMMING 9

Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Programming Types-Lead through Programming, Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effector commands and simple Programs.

UNIT-V IMPLEMENTATION OF ROBOTS 9

RGV, AGV; Implementation of Robots in Industries -Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- 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.

CO - PO and CO - PSO MAPPING

CO	PO												PSO		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	1	1	1				1					1	1	1
CO2	2	3	1	2					1	1			2	2	3
CO3	2	3	2	3		3	2	1	2	1		1	2	2	1
CO4	2	1			1										1
CO5	2	1	3	1	3	2	2	1			2	2	1	2	1
AVG.	2.2	1.8	1.4	1.4	0.8	1	0.8	0.6	0.6	0.4	0.4	0.6	1.2	1.4	1.4

OEI102	SENSORS FOR ENGINEERING APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To know the various stimuli that are to be measured in real life instrumentation.
- To select the rightprocess or phenomena of the sensor.
- To aware of the various sensors available for measurement and control applications.

UNIT-I INTRODUCTION TO SENSORS 9

What is a sensor and what is a transducer? Electrical sensor – need for sensors in the modern world. Different fields of sensors based on the stimuli - various schematics for active and passive sensors. General characteristics and specifications of sensors - Implications of specifications uses of sensors - measurement of stimuli - block diagram of sensor system. Brief description of each block.

UNIT-II TRANSDUCERS 9

Sensors for mechanical systems or mechanical sensors - Displacement - acceleration and force - flow of fluids - level indicators - pressure in fluids - stress in solids. Typical sensors - wire and film strain gauges, animometers, piezo electric and magnetostrictive accelerometers, potentiometric sensors, LVDT.

UNIT-III TEMPERATURE SENSORS 9

Thermal sensors – temperature – temperature difference – heat quantity. Thermometers for different situation – thermocouples thermistors – color pyrometry. Optical sensors: light intensity – wavelength and color – light dependent resistors, photodiode, photo transistor- Radiation detectors: radiation intensity, particle counter – Gieger Muller courter (gas based), Hallide radiation detectors.

UNIT-IV MAGNETIC SENSORS 9

Introduction- magnetic field, magnetic flux density – magneto resistors, Hall sensors, super conduction squids. Acoustic or sonic sensors: Intensity of sound,

frequency of sound in various media, various forms of microphones, piezo electric sensors.

UNIT-V ELECTRICAL SENSORS 9

Introduction- conventional volt and ammeters, high current sensors, (current transformers), high voltage sensors, High power sensors. High frequency sensors like microwave frequency sensors, wavelength measuring sensors. MEMs and MEM based sensors.

TOTAL: 45 PERIODS

COURSE OUTCOMES

- Appreciate the operation of various measuring and control instruments which they encounter in their respective fields.
- Visualize the sensors and the measuring systems when they have to work in areas of interdisciplinary nature.
- Also think of sensors and sensors systems when for a new situation they encounter in their career
- Identify and select the right process or phenomena on which the sensor should depend on.
- Know various stimuli that are to be measured in real life instrumentation.

TEXTBOOKS

1. Doebelin, “Measurement Systems: Application and Design”, McGraw Hill Kogakusha Ltd.
2. Julian W. Gardner, Vijay K. Varadan, Osama O. Awadelkarim “Microsensors, MEMS and Smart Devices”,New York: Wiley, 2001.
3. Henry Bolte, “Sensors – A Comprehensive Sensors”, John Wiley.

CO - PO and CO - PSO MAPPING

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	1	1	1	3	1	2	1	1	2		2
CO2	2		2	2			1								
CO3	2	2				1	1					1	1	2	
CO4	3	3	3	3	1			3	1	2					
CO5	2	1	2	1	1	1	1	2	1	1	1	1	2	2	2
AVG.	2.4	1.6	1.8	1.6	0.6	0.6	0.8	1.6	0.6	1	0.4	0.6	1	0.8	0.8

OIT101 MULTIMEDIA TECHNOLOGIES L T P C

3 0 0 3

OBJECTIVES:

- Provide a comprehensive understanding of multimedia concepts and components.
- Equip students with the knowledge to design and handle multimedia systems and files.
- Develop skills in multimedia authoring, hypermedia messaging, and user interface design.
- Introduce augmented reality techniques and their integration with existing development environments.
- Explore virtual reality techniques and their applications in creating immersive experiences.

UNIT- I: INTRODUCTION TO MULTIMEDIA 9

Multimedia - Multimedia system architecture − Evolving technologies for multimedia -Components of multimedia – Multimedia Hardware and Software-Web and Internet multimedia applications –Data Representation: Text, Images, Audio, Video - Transition from conventional media to digital media.

UNIT -II: MULTIMEDIA SYSTEM DESIGN & FILE HANDLING 9

Defining objects for multimedia systems − Multimedia data interface standards − Multimedia databases- Compression and decompression− Data and file format standards − Multimedia I/O technologies − Digital voice and audio − Video image and animation − Full motion video − Storage and retrieval technologies.

UNIT- III: HYPERMEDIA 9

Multimedia authoring and user interface - Hypermedia messaging -Mobile messaging − Hypermedia message component − Creating hypermedia message − Integrated multimedia message standards − Integrated document management − Distributed multimedia systems. CASE STUDY: Blender graphics and Fundamentals – Drawing Basic Shapes – Modelling – Shading & Textures.

UNIT- IV: AUGMENTED REALITY 9

Working with AR techniques, compatibility with the environment, system architecture, AR terminology, application areas of AR, Integration of AR toolkits with existing IDE's (Unity-Vuforia, Visual Studio, Netbeans, intellij IDEA, Android, iOS), connectivity of smart devices with AR.

UNIT -V: VIRTUAL REALITY 9

Integration of VR techniques, Contents objects and scale, Gaze Based Control, Handy Interactables, IDE setup with package files, concepts and features of VR, VR project example**.**

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Understand and explain the fundamental concepts of multimedia and its components.
2. Design and handle multimedia systems and files.
3. Develop and manage hypermedia content and applications.
4. Apply augmented reality techniques and integrate AR toolkits with various IDEs.
5. Develop virtual reality content and understand its applications and features.

TEXT BOOKS:

1. Multimedia: Making It Work (8th Edition) by Tay Vaughan and Fundamentals of Multimedia by Ze-Nian Li and Mark S. Drew Publisher, Unit 1, 2.
2. Yvonne, B., & Alistair, G. (1997). Multimedia and Hypertext: The Internet and Beyond. MIT Press. Unit 3
3. Dieter Schmalstieg and Tobias Hollerer, "Augmented Reality: Principles and Practice," Addison-Wesley Professional, 2016. Unit 4

4. Understanding Virtual Reality: Interface, Application, and Design (2nd Edition) by William R. Sherman and Alan B. Craig Publisher: Morgan Kaufmann, Unit 5.

REFERENCES:

1. Li, Z., Drew, M., & Liu, J. (2004). Fundamentals of Multimedia. Pearson. Judith Jeffcoate, “Multimedia in practice: Technology and Applications”, PHI, 1998.
2. Furht, B. (Ed.). (1998). Handbook of Multimedia Computing. CRC Press.
3. Billinghurst, M., Clark, A., & Lee, G. (2015). A Survey of Augmented Reality**.** Foundations and Trends® in Human–Computer Interaction, 8(2-3), 73-272.
4. Sherman, W. R., & Craig, A. B. (2018). Understanding Virtual Reality: Interface, Application, and Design (2nd ed.). Morgan Kaufmann.

List of Open Source Software/ Learning website:

1. Tay Vaughan, "Multimedia: Making It Work," Tata McGraw-Hill, 2008.
2. Ze-Nian Li and Mark S. Drew, "Fundamentals of Multimedia," Pearson Education, 2004.
3. Gaurav Bhatnagar and Shikha Mehta, "Introduction to Multimedia Systems," Cambridge University Press, 2000.
4. Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile," O'Reilly Media, 2015.

CO – PO – PSO Mapping

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	1	-	1	1	-	-	-	2	3	1	3	2	1
2	1	-	2	-	3	3	-	-	-	3	3	1	1	-	2
3	3	2	2	-	2	1	1	1	1	1	1	1	3	2	2
4	3	3	3	-	2	1	1	1	1	1	1	1	3	3	3
5	3	3	3	-	3	1	1	1	1	1	1	1	3	3	3
Avg	**2.6**	**2.4**	**2.4**	**-**	**2.2**	**1.4**	**1.0**	**1.0**	**1.0**	**1.6**	**1.8**	**1.0**	**2.6**	**2.0**	**2.3**

OIT102 **3D PRINTING & ITS APPLICATIONS** **L T P C**

3 0 0 3

OBJECTIVES:

- To develop CAD models for 3D printing.
- To import and export CAD data and generate. STL file.
- To select a specific material for the given application.
- To select a 3D printing process for an application.
- To produce a product using 3D printing or Additive Manufacturing (AM).

UNIT – I: 3D PRINTING (ADDITIVE MANUFACTURING) 9

Introduction, The Generic AM Process, Classification of AM Process, Advantages, Additive V/s Conventional Manufacturing processes, Applications-the Benefits of AM.

UNIT – II: CAD FOR ADDITIVE MANUFACTURING 9

Steps in Additive Manufacturing-Variation from one AM Machine to another-Application Areas That Don't Involve Conventional CAD Modeling-CAD Tools for AM -Preparation of CAD Models: The STL File, STL File Format, Binary/ASCII, Creating STL Files from a CAD System -Problems with STL Files.

UNIT – III: ADDITIVE MANUFACTURING TECHNIQUES 9

Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology. Process, Process parameter, Process, Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, HealthCare, 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 AND POST PROCESSING **9**

Process equipment- design and process parameters, Governing bonding mechanism, Common faults and troubleshooting, Process design, Post processing: requirement and techniques, Product quality, Inspection and testing, Defects and their causes

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the students will 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. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States, 2015, ISBN: 978-1-56990-582-1. (Unit I & II)
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015, ISBN13: 978-1493921126. (Unit II to V)

REFERENCES:

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 SeriesIn Material Science, 2013.
4. L. Lu, J. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”,Kulwer Academic Press, 2001.

5. Zhiqiang Fan And Frank Liou, “Numerical Modelling of the Additive Manufacturing
(AM)Processes of Titanium Alloy”, InTech, 2012.

CO – PO – PSO Mapping

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	-	2	-	-	-	-	-	-	-	-	2	-	-	-	-
2	-	2	3	-	2	-	-	-	-	-	-	2	-	-	-	-
3	-	-	2	2	-	-	-	-	-	-	-	-	-	-	3	2
4	-	-	-	3	2	-	-	-	-	-	2	-	-	-	3	2
5	-	-	2	3	2	-	-	-	-	-	-	-	-	-	2	1
Avg	**2**	**2**	**2.2**	**2.6**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**-**	**-**	**2.6**	**1.6**

OIT103 **WEB FRAMEWORKS** **L T P C**

3 0 0 3

OBJECTIVES:

- Design static web page using Markup languages.
- Design and implement web pages using style sheets.
- Implement with java script web applications with dynamic web pages.
- Understand working of Web servers and Design Methodologies with MVC
  Architecture.
- Develop web applications using XML.

UNIT- I: INTRODUCTION TO WEB FRAMEWORKS **9**

Basics of web development – Overview of web frameworks - MVC architecture - Popular web frameworks: Django, Flask, Ruby on Rails, Laravel, Express.js - Benefits of using web frameworks

UNIT- II : CLIENT- SIDE FRAMEWORKS **9**

Introduction to client-side frameworks - React.js: Components, JSX, State and Props, Lifecycle Methods - Angular: Modules, Components, Services, Directives, Data Binding - Vue.js: Vue instance, Templates, Components, Vue Router

UNIT- III : SERVER - SIDE FRAMEWORKS **9**

Introduction to server-side frameworks - Django: Models, Views, Templates, Forms, Admin Interface - Flask: Routing, Templates, WTForms, SQLAlchemy - Node.js with Express.js:Middleware, Routing, Templating, REST APIs

UNIT- IV: DATABASE INTEGRATION **9**

Database fundamentals - SQL vs NoSQL databases - ORM (Object-Relational Mapping) concepts - Integrating databases with Django (using Django ORM) - Integrating databases with Flask (using SQLAlchemy) - Integrating databases with Node.js using Mongoose for MongoDB

UNIT- V : FULL-STACK DEVELOPMENT **9**

Overview of full-stack development - RESTful APIs and Web Services - Authentication and Authorization - Deployment and Hosting - Case Studies: Building a full-stack application with React and Django/Node.js

TOTAL : 45 PERIODS

OUTCOMES:

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

- Understand the fundamental concepts and architecture of web frameworks.
- Develop web applications using client-side frameworks.
- Build dynamic server-side applications with popular server-side frameworks.
- Integrate databases and manage data within web applications.
- Implement full-stack web applications combining client side and server-side technologies.

TEXT BOOKS:

1. "Web Development with Node and Express: Leveraging the JavaScript Stack" by Ethan Brown Unit 1,3,4,5
2. "Django for Beginners: Build websites with Python and Django" by William S. Vincent Unit 1,3,5
3. "Learning React: A Hands-On Guide to Building Web Applications Using React and Redux" by Kirupa Chinnathambi Unit 2,5

REFERENCES:

1. **"**Flask Web Development: Developing Web Applications with Python" by Miguel Grinberg Unit 3,4
2. "Pro Angular 9: Build Powerful and Dynamic Web Apps" by Adam Freeman Unit 2
3. "Full-Stack Vue.js 2 and Laravel 5: Bring the frontend and backend together with Vue, Vuex, and Laravel" by Anthony Gore Unit 1,5

CO – PO – PSO Mapping

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	2	3	-	-	-	-	2	1	2	3	2	2	-
2	2	3	3	2	3	-	-	-	2	3	2	2	3	2	3	-
3	2	3	3	3	3	-	-	-	2	2	2	2	3	2	3	-
4	2	2	3	2	3	-	-	-	2	2	1	2	3	3	3	-
5	2	3	3	3	3	-	-	-	2	3	3	2	3	3	3	-
Avg	**2.2**	**2.6**	**2.8**	**2.4**	**3**	**-**	**-**	**-**	**1.6**	**2.4**	**1.8**	**2**	**3**	**2.4**	**2.8**	**-**

OME101 REFRIGERATION AND AIR CONDITIONING L T P C

3 0 0 3

COURSE OBJECTIVES

1. To introduce the underlying principles of operations in different Refrigeration & Air conditioning systems and components.
2. To provide knowledge on design aspects of Refrigeration & Air conditioning systems.
3. To study the Vapour absorption and air refrigeration systems.
4. To learn the psychrometric properties and processes.
5. To study the air conditioning systems and load estimation.

UNIT – I INTRODUCTION 9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT – II VAPOUR COMPRESSION REFRIGERATION SYSTEM 9

Vapor compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – subcooling and super heating- effects of condenser and evaporator pressure on COP- multipressure system -low temperature refrigeration - Cascade systems – problems. Equipments: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT – III OTHER REFRIGERATION SYSTEMS 9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration – Magnetic Vortex and Pulse tube refrigeration systems.

UNIT – IV PSYCHROMETRIC PROPERTIES AND PROCESSES 9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart;

Psychrometric of air-conditioning processes, mixing of air streams.

UNIT – V AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION 9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air

Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL:45 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1. Explain the basic concepts of Refrigeration
2. Explain the Vapor compression Refrigeration systems and to solve problems
3. Discuss the various types of Refrigeration systems
4. Calculate the Psychrometric properties and its use in psychrometric processes
5. Explain the concepts of Air conditioning and to solve problems

TEXT BOOKS:

1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010
2. Textbook of Refrigeration And Air-Conditioning (M.E.)by R.S. Khurmi | 10 February 2019

REFERENCES:

1. ASHRAE Hand book, Fundamentals, 2010
2. JonesW.P., "Air conditioning engineering", 5th edition, Elsevier

Butterworth-Heinemann, 2007

OME101	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO 1	2	1	1	1			2		1			1	2	2
CO 2	2	1	1	1			2		1			1	2	2
CO 3	2	1	1	1			2		1			1	2	2
CO 4	2	1	1	1			2		1			1	2	2
CO 5	2	1	1	1			2		1			1	2	2
Average	2	1	1	1			2		1			1	2	2

(1 – LOW, 2-MEDIUM, 3-HIGH)

OME102	ADVANCED MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is:

1. To describe the concepts of various metal casting processes.
2. To demonstrate the concepts of various metal joining processes.
3. To describe unconventional machining processes
4. To demonstrate thermal and electrical based processes.
5. To describe the chemical and electrochemical-based process parameters, their influence on performance, and their application.

UNIT-I: METAL CASTING **9**

Casting terminology, pattern material, allowance; Pattern types: Single piece, split, gated; Core prints, moulding sand properties, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Melting furnaces: Blast and Cupola Furnaces; Principle of special casting processes: Shell - investment - Ceramic mould - Pressure die casting - Centrifugal Casting - Stir casting; Defects in Sand casting

UNIT-II: JOINING PROCESSES **9**

Operating principle, basic equipment, merits and applications of fusion welding processes: Gas welding - Types - Flame characteristics; Manual metal arc welding - Gas Tungsten arc welding

- Gas metal arc welding - Submerged arc welding - Electro slag welding; Operating principle and applications of resistance welding - Plasma arc welding - Thermit welding - Electron beam welding - Friction welding and Friction Stir Welding. brazing, soldering and adhesive bonding; Weld defects: types, causes and cure.

UNIT-III: MECHANICAL ENERGY BASED PROCESSES **9**

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining - (AJM, WJM, AWJM and USM) - Working Principles – equipment used – Process

parameters – MRR- Applications.

UNIT-IV: THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipment - Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits- Tool Wear –Dielectric – Flushing – Applications. Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM) – Working Principles – Equipment –Types – Beam control techniques – Applications.

UNIT-V: CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro-Chemical machining (CHM and ECM) - Etchants – Maskant – techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- Equipment -Surface Roughness and MRR Electrical circuit -Process Parameters ECG and ECH – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Understand the various metal casting processes.
2. Understand the various metal joining techniques.
3. Describe the unconventional machining processes and the mechanical processes.
4. Understand the thermal and electrical-based processes.
5. Understand the chemical and electrochemical-based process parameters, their influence on performance, and their application.

TEXTBOOKS:

1. Serope Kalpakjian, Steven R.Schmid, “Manufacturing Engineering and Technology”, Pearson Education, Eighth Edition, 2020.
2. P.N. Rao, “Manufacturing Technology: Foundry, Forming and Welding – Volume 1”, Tata McGraw-Hill Publishing Limited, 2019.

REFERENCE BOOKS:

1. P.C. Sharma, “A text book of Production Technology (Manufacturing Processes)”,

   S. Chand and Company, 8th Edition 2014.

2. S.Gowri, P.Hariharan, and A.Suresh Babu, “Manufacturing Technology 1”,

   Pearson Education, 2020.

E- RESOURCES:

https://archive.nptel.ac.in/courses/112/107/112107219

https://archive.nptel.ac.in/courses/112/105/112105212

OME102	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		1		1		1		1	1		1	1	1
CO2	2		1		1		1		1	1		1	1	1
CO3	2		1		1		1		1	1		1	1	1
CO4	2		1		1		1		1	1		1	1	1
CO5	2		1		1		1		1	1		1	1	1
Average	2		1		1		1		1	1		1	1	2

(1-LOW, 2-MEDIUM, 3-HIGH)

OME103	MATERIAL TESTING AND CHARACTERIZATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is:

1. To describe the phase structure of metals/alloys.
2. To demonstrate the heat treatment process employed for various materials.
3. To describe the classification of ferrous and nonferrous alloys.
4. To describe the Practical exposure towards microstructure of Engineering Materials.
5. To demonstrate the Mechanical testing tools for engineering materials.

UNIT-I: BINARY PHASE DIAGRAM 9

Solid solutions: Substitutional and interstitial – Compound – Phase diagram: Classification - Phase reactions with an example: Isomorphous, eutectic, eutectoid, peritectic and peritectoid, Iron – Iron carbide diagram.

UNIT-II: HEAT TREATMENT PROCESSES 9

Full, stress relief, recrystallization and spherodizing annealing – normalizing, hardening and tempering of steel –phase transformation - Isothermal transformation (TTT) diagram for Eutectoid Steel – cooling curves - CCR –Hardenability - Jominy end quench test – Austempering - martempering. Case hardening - carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening

UNIT-III: FERROUS ALLOYS 9

Classification, properties, microstructure, processing and applications of low, medium & high carbon steel & FG, SG, White, Malleable cast iron – effect of alloying elements on steel (Cr, Mo, V, Ti, Ni & W) - stainless steel and tool steels - HSLA steel & Maraging steels – Die steel, Wear of Metals - BIS Specification.

UNIT-IV: NON-FERROUS ALLOYS 9

Properties, Composition, Applications: Copper and its alloys - Brass, Bronze and Cupronickel – Aluminium and its alloys – Duralumin- Bearing alloys. Nickel and Titanium base alloys – Metals for low and high temperature applications- BIS
Specification.

UNIT-V: MECHANICAL TESTING **9**

Mechanical properties - stress - strain curve for ferrous and non-ferrous alloys - Mechanism of plastic deformation, slip and twinning – Fracture: types – Griffith theory - Material testing: Tensile, compression and shear loads –Hardness tests: Brinell, Rockwell and Vickers - Impact test: Izod and Charpy - Fatigue and creep tests - fracture toughness tests - Characterization techniques: Optical, SEM, XRD.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. To recall the phase reactions of various metals and alloys.
2. To have great exposure in the heat treatment processes and know their purpose in engineering applications
3. To have knowledge in the classification, properties and applications of various ferrous alloys.
4. To classification and application of various nonferrous alloy materials.
5. To Identify the various mechanical properties for the ferrous and nonferrous alloys using modern testing facilities.

TEXTBOOKS:

1. Jindal. U.C “Material science and Metallurgy”, Pearson New Delhi, 2015.
2. Selvakumar N, “Engineering Metallurgy and Nanotechnology” Scitech, Publications (India) Pvt. Ltd., 2018

REFERENCE BOOKS:

1. Raghavan.V, “Materials Science and Engineering”, Prentice-Hall, 6th Edition, 2015.
2. William D Callister and David G. Rethwisch, “Material Science and Engineering: An Introduction”, John Wiley, 10th Edition, 2018.

E- RESOURCES:

https://nptel.ac.in/courses/112108150

https://www.digimat.in/nptel/courses/video/113107078/L01.html

OME103	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	3	1								1	1	1
CO2	3	1	3	1								1	1	1
CO3	3	1	3	1								1	1	1
CO4	3	1	3	1								1	1	1
CO5	3	1	3	1								1	1	1
Average	3	1	3	1								2	1	1

(1-LOW, 2-MEDIUM, 3-HIGH)

OME104	HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. At the end of the course the student shall be able to understand the type, nature of hazardous wastes.
2. T o study the hazardous wastes management.
3. To study the biomedical waste management.
4. To study the radioactive waste management.
5. To study the E-Waste Management.

UNIT I INTRODUCTION 9

Hazardous waste definition- Regulatory aspects of Hazardous Waste Management in India – Sources, characterization, categories - Analysis of hazardous waste -Physical and biological routes of transport of hazardous substances.

UNIT II HAZARDOUS WASTES MANAGEMENT 9

Handling, collection, storage and transport- TSDF concept -Hazardous waste treatment technologies-Physical, chemical and thermal treatment of hazardous waste–Solidification-Chemical fixation–Encapsulation-Pyrolysis and Incineration–Biological Treatment of Hazardous Waste, Hazardous waste landfills-Site selections-design and operation-HW reduction- Recycling and reuse–Hazardous Site remediation – onsite and offsite Techniques.

UNIT III BIOMEDICAL WASTE MANAGEMENT 9

Biomedical waste–Definition– Regulatory aspects of Biomedical Waste. Sources–Classification– Waste Handling and Collection–Segregation and labeling- Treatment – autoclaving, Incineration, Chemical Disinfection – disposal-Infection control Practices.

UNIT IV RADIOACTIVE WASTE MANAGEMENT 9

Radioactive waste: Definition–Measurement of Radiation -Sources-Effects -Low level and high level radioactive wastes-Transuranic Waste-and their management–Uranium Mine and Tailings, Characterization – Treatment and Control - Radiation standard by ICRP and AERB.

UNIT V E-WASTE MANAGEMENT 9

Regulatory aspects of E-l Waste management, Waste characteristics- Generation–- Collection - Material Composition-Transport– Treatment and disposal. Recycling and Recovery – intergraded e-waste management

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Gain the knowledge of the type, nature hazardous wastes.
2. Ability to plan minimization of hazardous wastes.
3. Ability to handle the bio medical Waste.
4. Ability to handle the radioactive waste.
5. Ability to handle the E- Waste Management.

TEXTBOOKS:

1. Hazardous waste management CharlesA.Wentz.Second edition 1995.McGraw Hill nternational.
2. Hazardous waste management Michael D. La Gerga, PhilipL Buckingham, Jeffrey C. Evans, Second edition 2010.Waveland Press.

REFERENCES:

1. Basic Hazardous waste management, “William C.Blackman.Jr”, Third Edition, 2001, Lewis Publishers
2. Integrated solid waste management George Techobanoglous, Hilary Theisen & Sammuel A.Vigil.

OME104	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1				3		1			1	1	2
CO2	2	1	1				3		1			1	1	2
CO3	2	1	1				3		1			1	1	2
CO4	2	1	1				3		1			1	1	2
CO5	2	1	1				3		1			1	1	2
Average	**2**	**1**	**1**				**3**		**1**			**1**	**1**	**2**

(1-LOW, 2-MEDIUM, 3-HIGH)

OME105	AUTOMOTIVE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. The intention and purpose of this course is to study the basics of electronics, emission controls and its Importance in automobiles.
2. To study the Ignition and Injection system in Automobiles
3. To study the various sensors and actuators used in automobiles for improving fuel economy and emission control.
4. To study the various blocks of mechatronics control units used for control of fuel, ignition and exhaust systems.
5. To learn about different types of chassis and mechatronics safety systems in automobile.

UNIT I **INTRODUCTION** **9**

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT II **IGNITION AND INJECTION SYSTEMS** **9**

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

UNIT III **SENSOR AND ACTUATORS IN AUTOMOTIVES** **9**

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, and vacuum operated actuator.

UNIT IV ENGINE CONTROL SYSTEMS 9

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard – diagnostics systems in modern automobiles.

UNIT V CHASSIS AND SAFETY SYSTEMS 9

Traction control system – Cruise control system – electronic control of automat transmission –antilock braking system – electronic suspension system – working of air ba and role of MEMS in airbag systems – centralized door locking system – climate control cars.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Know the importance of emission standards in automobiles.
2. Understand the electronic fuel injection and ignition components and their function.
3. Choose and use sensors and equipment for measuring mechanical quantities temperature and appropriate actuators.
4. Diagnose electronic engine control systems problems with appropriate diagnostic tools.
5. Analyze the chassis and vehicle safety system.

TEXTBOOKS:

1. Ribbens, "Understanding Automotive Electronics", 8th Edition, Elsevier, Indian Reprint, 2017.

2. Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", Delmar Publishers, 7th edition, 2019.

REFERENCES:

1. Richard K. Dupuy “Fuel System and Emission controls”, Check Chart Publication,4th edition, 2000.
2. Ronald. K. Jurgon, “Automotive Electronics Handbook”, McGraw-Hill, 1999.

OME105	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	1	1						1	1	1	2
CO2	3	2	1	1	1						1	1	1	2
CO3	3	2	1	1	1						1	1	1	2
CO4	3	2	1	1	1						1	1	1	2
CO5	3	2	1	1	1						1	1	1	2
Average	**3**	**2**	**1**	**1**	**1**						**1**	**1**	**1**	**2**

(1-LOW, 2-MEDIUM, 3-HIGH)

OCH101 **NANOMATERIALS AND APPLICATIONS** **L T P C**

Seventh Semester- B.E./B.Tech., **3 0 0 3**

(Common to all branches)

OBJECTIVES

- To make the students familiar with the properties and applications of nanomaterials.
- To acquaint the student with the synthesis of nanomaterials by different methods.
- To provide knowledge on the different characterisation techniques employed to characterise the nanomaterials.
- To inculcate the students on the knowledge of nanocomposites, biodegradable polymer-based nanocomposites, and clay polymer nanocomposites.
- To enlighten the needs and utilization of nanomaterials in various fields such as energy, water treatment process, agriculture, electronics, medicine, engineering and Information technology.

UNIT I PROPERTIES OF NANOMATERIALS 9

Definition – importance of nano structured materials - size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials. Surface area - band gap energy and its applications. Photochemistry and electrochemistry of nanomaterials –ionic properties of nanomaterials- Nanocatalysis. Green Materials – biomaterials, biopolymers and bioplastics.

UNIT II SYNTHESIS OF NANOMATERIALS 9

Bottom-up and top-down approach to obtain nanomaterials. Chemical methods: co-precipitation methods, sol-gel technique, photochemical synthesis. Physical methods: high energy ball milling, PVD methods, gas phase condensation and magnetron sputtering.

UNIT III STRUCTURAL CHARACTERISTICS 9

Introduction, principles, instrumentation and applications of powder X-ray diffraction, scanning electron microscopy, transmission electron microscopy, scanning probe microscopy, nanoindentation, small angle X-ray and neutron scattering and BET analysis method.

UNIT IV NANOCOMPOSITES 9

Introduction, the importance of nanocomposites, binary and ternary nanocomposites. Synthesis, properties and applications of metal-metal oxide and metal oxide-metal oxide nanocomposites, biodegradable polymer-based nanocomposites, thermoplastic nanocomposites, nylon-6 nanocomposites, clay polymer nanocomposites.

UNIT V APPLICATIONS OF NANOMATERIALS 9

Introduction, applications of nanomaterials in renewable energy generation, drug delivery, cosmetics, tissue engineering, bioinformatics, nanomedicine, molecular motors, bioelectronics & spintronics, textiles, cosmetics, agriculture & food technology, high integrated circuits, information technology, defence and aerospace. Practice of nanoparticles for environmental remediation and water treatment.

Total Periods: 45

OUTCOMES

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

1. Evaluate and understand the different types of nanomaterials and their properties.
2. Understand the proper methods for synthesizing nanomaterials.
3. Recommend the characterization techniques for various nanomaterials.
4. Illustrate the functioning and properties of nanocomposites and their interference.
5. Develop a more profound knowledge on the applications of nanomaterials in various fields.

TEXTBOOKS

1. C. N. R. Rao, Achim Muller, Anthony K. Cheetham, “The Chemistry of Nanomaterials: Synthesis, Properties and Applications”, 2nd Edition Wiley-VCH, Germany, 2006.
2. Geoffrey A. Ozin, Andre C. Arsenault, Ludovico Cademartiri, Chad A. Mirkin, “Nanochemistry: A Chemical Approach to Nanomaterials”, RSC Publishing, 2nd Edition, United Kingdom, 2008.
3. Azamal Husen, Khwaja Salahuddin Siddiqi, “Advances in Smart Nanomaterials and their Applications (Micro and Nano Technologies)”, 1st Edition, Elsevier, Netherlands, 2023.

REFERENCES

1. William A Goddard “Handbook of Nanoscience, Engineering and Technology”, 3rd Edition, CRC Taylor and Francis, United Kingdom, 2012.
2. G. Cao, “Nanostructures & Nanomaterials: Synthesis, Properties & Applications”, Imperial College Press, London, 2004.
3. N. Kumar, “Concise concepts of nanoscience and nanomaterials”, Scientific publishers, New Delhi, 2019.

4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Text book of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, Hyderabad, 2018.
5. Korada, Viswanatha Sharma, Hamid, Nor Hisham, Engineering Applications of Nanotechnology: From Energy to Drug Delivery, Springer, United States, 2017.

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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO4	2	1	1	1	-	1	-	1	-	-	-	1	-	-	-	-
CO5	2	1	1	1	1	1	-	1	-	-	-	1	-	-	-	-
AVG	2	0.6	0.8	0.4	0.2	0.2	-	0.2	-	-	-	0.8	-	-	-	-

1 - low, 2 - medium, 3 - high, ‘-' - no correlation

OPH101 **ADVANCED FUNCTIONAL MATERIALS** **L T P C**

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

OBJECTIVES:

- To understand the sensors and actuators
- To facilitate the knowledge about photoactive functional soft materials
- To enrich the idea of Functional magnetic materials
- To explore bio mimics, bionics and bio mineralization
- To enhance the fundamental knowledge about Energy Functional materials and molecular Electronics

UNIT I FUNCTIONAL MATERIALS FOR SENSORS AND ACTUATORS 9

Introduction of sensors - differences between transducers, Sensors and Actuators-Conducting polymers sensor materials- Conducting polymer FET sensor - Chemi resistive sensor. Introduction of actuators and its working principle - Electrochromic and Electroactive Polymer actuators: Wet and Dry Electroactive polymer actuators (EAP).

UNIT II PHOTOACTIVE FUNCTIONAL SOFT MATERIALS 9

Introduction - soft materials-photo thermal effect-photo isomerisation-photo switches - opto fluidics. micro soft robotics-light driven micro pumps and micro mixers – Photo acutuation. Photo tunable photonic crystals-photo patterning and alignment. Optical control in a chiral photo magnet.

UNIT III FUNCTIONAL MAGNETIC MATERIALS 9

Magneto caloric effect-magnetic cooling and heating-Magneto caloric materials for heat pumping applications. Soft magnetic wires for sensor applications-Magnetic bistability and domain wall propagation. slow magnetic relaxation-magnetic molecular materials - single molecule magnets-single ion magnets - single chain magnets - molecular spin qubits.

UNIT IV ENERGY MATERIALS AND MOLECULAR ELECTRONICS 9

Electro chemical capacitor - super capacitors for energy storage - single junction solar cell-Tandem solar cell - Dye sensitized solar cells – Quantum dot solar cell - Organic solar cells – Semiconductor nanostructures. Superconductors for energy storage systems and transportation. Organic electronics- Organic LED – spintronics - dilute magnetic semiconductors.

UNIT V BIO-INSPIRED MATERIALS 9

Bio-inspired materials, Classification, Biomimics, Spider Silk, Lotus Leaf, Gecko feet, Synovial fluid,'Bionics' - Bio-inspired Information Technologies, Artificial Sensory Organs, Biomineralization-En route to Nanotechnology; Biometals – bioceramics- bio synthetic polymers.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course,

- The students will gain knowledge on the basics of conducting polymer sensors, actuators and FET sensors.
- The students will have adequate knowledge on the soft materials, and micro soft robotics.
- The students will have knowledge on the concepts Magneto caloric effect, magnetic cooling and heating.
- The students will understand the basics of Bio-inspired materials and Bio-inspired Information Technologies
- The students will get knowledge on electro chemical capacitor and spintronics.

TEXT BOOKS:

1. Hasse Fredriksson, KTH Stockholm, Sweden and Ulla Åkerlind University of Stockholm, Sweden 'Physics of Functional Materials'John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England, 2008.
2. S Banerjee, A.K. Tyagi, 'Functional Materials- Preparation, Processing and Applications' Elsevier , 2011.
3. Chander Prakash, Sunpreet Singh, J. Paulo Davim, 'Functional and Smart Materials',CRC Press ,2020.
4. Arcady Zhukov, 'Novel Functional Magnetic Materials- Fundamentals and Applications',Springer International Publishing, 2016.
5. Insup Noh, 'Biomimetic Medical Materials- From Nanotechnology to 3D Bioprinting', Springer Singapore, 2018.

REFERENCE BOOKS:

1. Quan Li , 'Photoactive Functional Soft Materials Preparation, Properties, and Applications'Wiley-VCH ,2019.
2. Hee-Gweon Woo, Hong Li, 'Advanced Functional Materials', Springer , 2011.
3. Rupitsch, Johann, S., Piezoelectric Sensors and Actuators. Springer-Verlag Berlin Heidelberg, 2018.
4. G. Arthanareeswaran, Pei Sean Goh, S. A. Gokula Krishnan , 'Functional Polymers and Nanomaterials for Emerging Membrane Applications',CRC Press ,2023.

Course Outcomes	PROGRAM OUTCOMES												PSOs			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	2	-	-	1	1	-	-	-	-	1	-	-	-	-
2	3	2	2	1	2	1	1	-	-	-		1	-	-	-	-
3	3	2	1	1	2	1	1	-	-	-	-	1	-	-	-	-
4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
5	3	2	1	1	1	1	1	-	-	-	-	1	-	-	-	-
Avg	3	1.8	1.6	1	1.5	1	1	-	-	-	-	1	-	-	-	-

1 - low, 2 – medium, 3 – high, '-' – no correlation

COURSES IN MINOR DEGREE
OFFERED BY DEPARTMENT OF MANAGEMENT STUDIES
DEPARTMENT OF AGRICULTURAL ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FOR B.E / B.TECH (HONOURS) / OPTIONAL COURSES (R2023)

ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

Enrolment for B.E. / B. Tech. (Honours) / Minor degree (Optional) A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E./B.Tech. (Honours) Minor degree. For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only. For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes, Moreover, for minor degree the student can register for courses from any one of the following verticals also. Complete details are available in clause 19 of Regulations 2023.

VERTICALS FOR MINOR DEGREE (In addition to all the verticals of other programmes)

VERTICAL I	VERTICAL II	VERTICAL III	VERTICAL IV	VERTICAL V
Fintech and Block Chain	**Entrepreneurship**	**Public Administration**	**Business Data Analytics**	**Environment and Sustainability**
Financial Management	Foundations of Entrepreneurship	Principles of Public Administration	Statistics for Management	Sustainable infrastructure Development
Fundamentals of Investment	Team Building and Leadership Management	Constitution of India	Data mining for Business Intelligence	Sustainable Agriculture and Environmental Management
Banking, Financial Services and Insurance	Creativity and Innovation in Entrepreneurship	Public Personnel Administration	Human Resource Analytics	Sustainable Bio Materials
Introduction to Block chain and its Applications	Principles of Marketing Management for Business	Administrative Theories	Marketing and Social Media Web Analytics	Materials for Energy Sustainability
Fintech Personal Finance and Payments	Human Resource Management for Entrepreneurs	Indian Administrative System	Operation and Supply Chain Analytics	Green Technology
Introduction to Fintech	Financing New Business Ventures	Public Policy Administration	Financial Analytics	Environmental Quality Monitoring and Analysis

VERTICAL I: FINTECH AND BLOCKCHAIN								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM101	Financial Management	PEC	3	0	0	3	3
2	BAM102	Fundamentals of Investment	PEC	3	0	0	3	3
3	BAM103	Banking, Financial Services and Insurance	PEC	3	0	0	3	3
4	CSM101	Introduction to Blockchain and its Applications	PEC	3	0	0	3	3
5	BAM104	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6	BAM105	Introduction to Fintech	PEC	3	0	0	3	3

VERTICAL II: ENTREPRENEURSHIP								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM201	Foundations of Entrepreneurship	PEC	3	0	0	3	3
2	BAM202	Team Building and Leadership Management for Business	PEC	3	0	0	3	3
3	BAM203	Creativity and Innovation in Entrepreneurship	PEC	3	0	0	3	3
4	BAM204	Principles of Marketing Management for Business	PEC	3	0	0	3	3
5	BAM205	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6	BAM206	Financing New Business Ventures	PEC	3	0	0	3	3

VERTICAL III: PUBLIC ADMINISTRATION								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM301	Principles of Public Administration	PEC	3	0	0	3	3
2	BAM302	Constitution of India	PEC	3	0	0	3	3
3	BAM303	Public Personnel Administration	PEC	3	0	0	3	3
4	BAM304	Administrative Theories	PEC	3	0	0	3	3
5	BAM305	Indian Administrative System	PEC	3	0	0	3	3
6	BAM306	Public Policy Administration	PEC	3	0	0	3	3

VERTICAL IV: BUSINESS DATA ANALYTICS								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM401	Statistics For Management	PEC	3	0	0	3	3
2	BAM402	Data Mining For Business Intelligence	PEC	3	0	0	3	3
3	BAM403	Human Resource Analytics	PEC	3	0	0	3	3
4	BAM404	Marketing And Social Media Web Analytics	PEC	3	0	0	3	3
5	BAM405	Operation And Supply Chain Analytics	PEC	3	0	0	3	3
6	BAM406	Financial Analytics	PEC	3	0	0	3	3

VERTICAL V: ENVIRONMENT AND SUSTAINABILITY							
Course Code	Course Title	Category	Contact Periods				C
			L	T	P	Total	
AGM501	Sustainable infrastructure Development	PEC	3	0	0	3	3
AGM502	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
AGM503	Sustainable Bio Materials	PEC	3	0	0	3	3
AGM504	Materials for Energy Sustainability	PEC	3	0	0	3	3
AGM505	Green Technology	PEC	3	0	0	3	3
AGM506	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3

VERTICAL 1: FINTECH AND BLOCKCHAIN

BAM101	FINANCIAL MANAGEMENT	L T P C 3 0 0 3

COURSE OBJECTIVES

1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance.
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy.
5. To develop an understanding of tools on Working Capital Management.

UNIT I INTRODUCTION TO FINANCIAL MANGEMENT 9

Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of Money-Risk and return concepts.

UNIT II SOURCES OF FINANCE 9

Long term sources of Finance-Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits etc.

UNIT III INVESTMENT DECISIONS 9

Investment Decisions: Capital budgeting – Need and Importance –Techniques of Capital Budgeting- Payback - ARR – NPV – IRR – Profitability Index. Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock - Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV FINANCING AND DIVIDEND DECISION 9

Capital Structure – determinants of Capital structure- Designing an Optimum capital structure. Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - Determinants of Dividend Policy.

UNIT V WORKING CAPITAL DECISION 9

Working Capital Management: Working Capital Management - concepts - importance - Determinants of Working capital - Working capital operating cycle. Cash Management: Motives for holding cash – Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will have an understanding on Time value of money and role of a finance manager.
2. Students will be able to analyze the various avenues available to generate long term funds for investments through capital markets and other sources.
3. Students will be able to apply various techniques for Investment decisions.
4. Students will be able to choose the right approach for financing and dividend decisions to solve business issues.
5. Students will be able to analyze the requirement and management of working capital.

REFERENCES

1. M.Y. Khan and P.K. Jain Financial Management, text, problems and cases Tata McGraw Hill, 8th edition 2017.
2. I.M. Pandey Financial Management, Vikas Publishing House Pvt. Ltd., 11th edition, 2018.
3. Prasanna Chandra, Financial Management – Theory and Practice, 9th edition, Tata McGraw Hill, 2017.
4. Rajiv Srivastava and Anil MisraFinancial Management, Oxford University Press, 2011.
5. Parasuraman, N.R Financial Management: a step-by-step approach, 2nd edition; Cengage Learning India Pvt. Ltd., 2019.

BAM102 **FUNDAMENTALS OF INVESTMENT** **L T P C**
3 0 0 3

COURSE OBJECTIVES

1. To describe the investment environment and understand the factors influencing investment decisions.
2. To explain the methods of valuing bonds and equities.
3. To examine various approaches used in the valuation of securities.
4. To understand the principles of portfolio construction and the role of diversification in creating efficient portfolios.
5. To discuss the mechanisms of investor protection in India, including regulatory frameworks and investor rights.

UNIT I THE INVESTMENT ENVIRONMENT 9

The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT II FIXED INCOME SECURITIES 9

Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating. Yield Measures: Current Yield, Yield to Maturity (YTM), Yield to Call (YTC) Money Market Instruments (Treasury Bills, Certificates of Deposit, Commercial Paper). Credit Rating Agencies in India (CRISIL, ICRA, CARE, India Ratings)

UNIT III APPROACHES TO EQUITY ANALYSIS 9

Introduction to Fundamental Analysis, Technical, Analyze macroeconomic indicators: GDP, interest rates, inflation, etc. Sector and industry analysis (Porter's Five Forces). Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES 9

Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India.

UNIT V INVESTOR PROTECTION 9

Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors' awareness and activism. Concept of Fair Disclosure and Transparency. Sustainable Investing and ESG.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will understand basic investment concepts and their significance, and analyze various investment avenues including stocks, bonds, mutual funds, real estate, commodities, and financial derivatives.
2. Students will evaluate risk and return profiles of different investment options using appropriate tools and techniques, and interpret market trends and economic indicators to make informed investment decisions.
3. Students will be able to apply principles of portfolio construction and management to optimize investment returns.
4. Students can able to develop a long-term investment strategy aligned with financial goals and risk appetite.
5. Students can able to explain the regulatory framework for investor protection in India and the principles of sustainable and ethical investing.

REFERENCES

1. Pinto, J. E., Henry, E., Robinson, T. R., & Stowe, J. D. Equity Asset Valuation (4th ed.). Wiley India 2023.
2. Chandra, P. Fundamentals of Investment (Revised ed.). McGraw-Hill Education 2022.
3. Mishkin, F. S., & Eakins, S. G. Financial Markets and Institutions (9th ed., Indian adaptation by Aparna Pujari 2021.
4. Sundaresan, S. Fixed Income Securities (4th ed.). McGraw-Hill Education 2021.
5. Graham, B., & Dodd, D. Security Analysis (7th ed.). McGraw-Hill Education 2020.

BAM103 BANKING, FINANCIAL SERVICES AND INSURANCE L T P C
3 0 0 3

COURSE OBJECTIVES

1. To understand the Banking system in India.
2. To grasp how banks, raise their sources and how they deploy it.
3. To understand the development in banking technology.
4. To understand the financial services in India.
5. To understand the insurance Industry in India.

UNIT I INTRODUCTION TO INDIAN BANKING SYSTEM 9

Overview of Banking system–Structure– Functions–Banking system in India –Key Regulations in Indian Banking sector –RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II MANAGING BANK FUNDS / PRODUCTS 9

Liquid Assets - Investment in securities - Advances - Loans. Negotiable Instruments – Cheques, Bills of Exchange & Promissory Notes. Designing deposit schemes– Asset and Liability Management – NPA's – Current issues on NPA's – M&A's of banks into securities market

UNIT III DEVELOPMENT IN BANKING TECHNOLOGY 9

Payment system in India – paper based – e payment –electronic banking –plastic money – e-money –forecasting of cash demand at ATM's –The Information Technology Act, 2000 in India – RBI's Financial Sector Technology vision document – security threats in e-banking & RBI's Initiative.

UNIT IV FINANCIAL SERVICES 9

Introduction – Need for Financial Services – Financial Services Market in India – NBFC –– Leasing and Hire Purchase –– mutual funds. Venture Capital Financing –Bill discounting – factoring – Merchant Banking

UNIT V INSURANCE 9

Insurance –Concept - Need - History of Insurance industry in India. Insurance Act, 1938 – IRDA – Regulations – Life Insurance - Annuities and Unit Linked Policies - Lapse of the Policy – revival – settlement of claim

TOTAL :45 PERIODS

COURSE OUTCOMES

1. Students will be able to identify and describe the roles and interrelationship of institutions in the banking, financial services, and insurance sectors.
2. Students will understand key functions such as deposits, loans, credit creation, and payment systems in both commercial and central banking.
3. Students will analyze various products such as savings accounts, fixed deposits, mutual funds, credit cards, and insurance policies.
4. Students will demonstrate an understanding of the regulatory environment, including acts, guidelines, and the roles of RBI, SEBI, IRDAI, etc.
5. Students will assess the impact of digital banking, and e-insurance services on customer experience and operational efficiency.

REFERENCES

1. Padmalatha Suresh and Justin Paul, “Management of Banking and Financial Services, Pearson, Delhi, 2017.
2. Meera Sharma, “Management of Financial Institutions – with emphasis on Bank and Risk Management”, PHI Learning Pvt. Ltd., New Delhi 2010.
3. Peter S.Rose and Sylvia C. and Hudgins,“Bank Management and Financial Services”, Tata McGraw Hill, New Delhi, 2017.
4. Indian Financial System M. Y. Khan, McGraw Hill Education, 2019 10th Edition.
5. Financial Markets and Institutions, L. M. Bhole & Jitendra Mahakud, McGraw Hill Education, 2021 6th Edition.

CSM101 INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS L T P C

3 0 0 3

COURSE OBJECTIVES:

- To understand Blockchain's fundamental components, and examine decentralization using blockchain.
- To explain how cryptocurrency works, from when a transaction is created to when it is considered part of the Blockchain.
- To explain the components of Ethereum and Programming Languages for Ethereum.
- To study the basics of Hyperledger and Web3.
- To know about alternative Blockchains and Blockchain projects in different domains.

UNIT I INTRODUCTION TO BLOCKCHAIN 9

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem centralization – Platforms for Decentralization.

UNIT II INTRODUCTION TO CRYPTOCURRENCY 9

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts.

UNIT III ETHEREUM 9

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

UNIT IV WEB3 AND HYPERLEDGER 9

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT V ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS 9

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Understand the technology components of Blockchain and how it works behind the scenes.
2. Understand Bitcoin and its limitations by comparing with other alternative coins.
3. Devise solution using the Ethereum model.
4. Understand and use Hyperledger and its development framework.
5. Track alternative Blockchains and emerging trends in Blockchain.

TEXTBOOK:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology,Decentralization and Smart Contracts Explained”, Second Edition, Packt Publishing,2018.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.
2. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly, 2014.
3. Roger Wattenhofer, “The Science of the Blockchain” CreateSpace Independent Publishing, 2016.
4. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.
5. Alex Leverington, “Ethereum Programming” Packt Publishing, 2017.

CSM101	PROGRAM OUTCOMES												PSO’s			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	1	-	-	3	-	-	1	-	-	3	-	-	-
CO2	-	3	3	-	-	-	-	3	3	-	-	-	-	3	-	-
CO3	-	-	3	1	-	-	-	-	3	1	-	-	-	-	3	-
CO4	3	-	-	-	-	-	3	-	-	-	-	-	1	1	-	-
CO5	-	-	-	-	3	-	-	-	-	-	3	-	2	3	1	3
CON	**3**	**3**	**3**	**1**	**3**	**-**	**3**	**3**	**3**	**1**	**3**	**-**	**2**	**2.3**	**2**	**3**

BAM104 FINTECH PERSONAL FINANCE AND PAYMENTS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce the foundational concepts of Financial Technology (FinTech) and its applications in personal finance, inclusive finance, and digital financial services.
2. To familiarize students with digital payment systems and cryptocurrencies, including their underlying technologies, security concerns, and legal frameworks.
3. To provide insights into InsurTech innovations, focusing on the integration of AI, ML, and IoT in risk management, underwriting, and fraud detection in insurance.
4. To enable understanding of peer-to-peer lending models and crowdfunding ecosystems, with a focus on digital infrastructure and financing solutions for SMEs and MSMEs.
5. To develop awareness of global and domestic FinTech regulations, and the emergence of RegTech as a tool for ensuring regulatory compliance and fraud monitoring using AI.

UNIT I INTRODUCTION TO FINTECH AND DIGITAL FINANCE 9

Overview of FinTech: Definition, scope, applications. History of Financial Innovation and Digitization. Alternative Finance: Crowdfunding – Types (Charity, Equity), platforms. Introduction to Initial Coin Offering (ICO). Role of FinTech in personal finance and inclusive finance.

UNIT II DIGITAL PAYMENTS AND CRYPTOCURRENCIES 9

Introduction to Cryptocurrencies: Bitcoin and Applications. Types of Cryptocurrencies and Digital Wallets. Basics of Blockchain Technology. National Payment Systems: Real-Time Gross Settlement (RTGS), Immediate Payment Service (IMPS), Unified Payments Interface (UPI). Digital Payments: Smart Cards, Mobile Payments, Payment Gateways, Virtual Currencies. Legal, Security, Privacy, and Ethical Issues in Digital Transactions.

UNIT III INSURTECH AND DIGITAL INSURANCE INNOVATIONS 9

Introduction to InsurTech. Role of (Artificial Intelligence (AI), Machine Language (ML), and Internet of Things (IoT) in insurance services. Risk Modelling, Fraud Detection. Innovations in Claims Processing and Underwriting. Impact on traditional insurance business models.

UNIT IV P2P LENDING AND FINANCIAL INCLUSION 9

Peer-to-Peer (P2P) and Marketplace Lending. Architecture and Technology Platforms. Crowdfunding Unicorns and Business Models. Financing for SME/MSME – Opportunities, Challenges, and FinTech Solutions.

UNIT V FINTECH REGULATIONS AND REGTECH 9

Global and Indian FinTech Regulations. Legal and Regulatory Risks. RegTech: Definition, Evolution. RegTech Ecosystem – Institutions, Startups, Regulators. Role of AI in Compliance and Fraud Monitoring.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to explain the fundamentals of cryptocurrencies, digital wallets, blockchain and payment systems such as UPI, RTGS, and IMPS, along with related security and regulatory aspects.
2. Students will describe the evolution of digital finance and analyze alternative finance models like crowdfunding and Initial Coin Offerings (ICO).
3. Students will evaluate the role of AI, ML, and IoT in InsurTech applications such as underwriting, claims processing, risk modeling, and fraud detection.
4. Students will analyze P2P lending and crowdfunding platforms, infrastructure, and innovations for SME/MSME financing.
5. Students will interpret FinTech regulations and assess the role of RegTech and AI in ensuring compliance and detecting fraud.

REFERENCES

1. Swanson, Seth Fintech for Beginners*:* Understanding and Utilizing the Power of Technology. Create Space Independent Publishing Platform 2016.
2. Tanda, Alessandra & Schena, Cristiana-Maria FinTech, BigTech and Banks: Digitalisation and Its Impact on Banking Business Models. Springer 2019.
3. Diedrich, Henning Ethereum : Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations. Wildfire Publishing 2016.
4. William, Jacob Fin Tech: The Beginner's Guide to Financial Technology. Create Space Independent Publishing Platform 2016.
5. Indian Institute of Banking and Finance (IIBF) Digital Banking. Taxmann Publications 2016.

BAM105	INTRODUCTION TO FINTECH	LT P C
		3 0 0 3

COURSE OBJECTIVES

1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION 9

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY 9

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY 9

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry-P2P insurance, On- Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.

UNIT IV FINTECH AROUND THE GLOBE 9

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

UNIT V FUTURE OF FINTECH 9

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech

Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to understand and describe the historical phases of FinTech.
2. Students can able to recognize how FinTech is revolutionizing payments, lending, wealth tech, insurance, and emerging sectors across different regions.
3. Students can able to understand the nuances of fintech in wealth management industry.
4. Students can able to compare major FinTech hubs and understand strategic collaborations between traditional financial institutions and tech firms.
5. Students will understand the future of fintech.

REFERENCES

1. Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015
2. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016
3. Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
5. Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications,2020

VERTICAL 2: ENTREPRENEURSHIP

BAM201 FOUNDATIONS OF ENTREPRENERUSHIP L T P C
3 0 0 3

COURSE OBJECTIVES

1. To develop and strengthen the entrepreneurial quality and motivation of learners.
2. To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
3. To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.
4. To empower the learners to run a Technology driven business efficiently and effectively.
5. To cultivate entrepreneurial skills, increase awareness of entrepreneurship, and foster a culture of innovation and job creation.

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

Entrepreneurship- Definition, Need, Scope -Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs -Factors affecting entrepreneurial development – Barriers to Entrepreneurship– Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT II BUSINESS OWNERSHIP & ENVRIONMENT 9

Types of Business Ownership – Business Environmental Factors – Political-Economic-Sociological- Technological-Environmental-Legal aspects – Human Resources Mobilisation-Basics of Managing Finance- Essentials of Marketing Management - Production and Operations Planning – Systems Management and Administration

UNIT III FUNDAMENTALS OF TECHNOPRENEURSHIP 9

Introduction to Technopreneurship - Definition, Need, Scope- Emerging Concepts- Principles - Characteristics of a technopreneur - Impacts of Technopreneurship on Society – Economy-Job Opportunities in Technopreneurship - Recent trends- Managing Techno Stress – Eustress and Distress – Coping Strategies of Techno Stress.

UNIT IV APPLICATIONS OF TECHNOPRENEURSHIP 9

Technology Entrepreneurship - Local, National and Global practices - Intrapreneurship and Technology interactions, Networking of entrepreneurial activities – Launching - Managing Technology based Product / Service entrepreneurship – Success Stories of Technopreneurs - Case Studies.

UNIT V EMERGING TRENDS IN ENTREPRENERUSHIP 9

Effective Business Management Strategies for Franchising - Sub-Contracting- Leasing- Technopreneurs – Agripreneurs - Netpreneurs- Portfolio entrepreneurship - NGO Entrepreneurship – Recent Entrepreneurial Developments - Local – National – Global perspectives.

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will be able to learn the basics of Entrepreneurship.
2. Students can understand the business ownership patterns and environment.
3. Students can understand the Job opportunites in Industries relating to Technopreneurship.
4. Students will learn about applications of technopreneurship and successful technopreneurs.
5. Students will acquaint with the recent and emerging trends in entrepreneurship.

REFERENCES

1. S.S. Khanka, “Entrepreneurial Development” S. Chand & Co.Ltd.Ram Nagar New Delhi, 2021.
2. Donal F Kuratko Entrepreneurship (11th Edition) Theory, Process, Practice by Published 2019 by Cengage Learning.
3. Daniel Mankani. Technopreneurship: The successful Entrepreneur in the new Economy. Prentice Hall 2003.
4. Edward Elgar. Entrepreneurship, Cooperation and the Firm: The Emergence and Survival of High-Technology Ventures in Europe. Edi: Jan Ulijn, Dominique Drillon, and Frank Lasch. Wiley Pub 2007.
5. Lang,J.TheHigh-TechEntrepreneur'sHandbook,Ft.com 2002.

BAM202 TEAM BUILDING AND LEADERSHIP MANAGEMENT FOR BUSINESS LT P C
3 0 0 3

COURSE OBJECTIVES

1. To develop and strengthen the Leadership qualities and motivation of learners.
2. To impart the Leadership skills and traits essential to become successful entrepreneurs.
3. To apply the principles and theories of Team Building in managing Technology oriented businesses.
4. To empower the learners to build robust teams for running and leading a business efficiently and effectively.
5. To emphasize the importance of ethics and values in leadership practices.

UNIT I INTRODUCTION TO MANAGING TEAMS 9

Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancingteamworkwithinagroup-TeamCoaching-TeamDecisionMaking-VirtualTeams-Self Directed Work Teams (SDWTs) -Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS 9

Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High- Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP 9

Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation – Effective Communication in Leadership - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV LEADERSHIP IN ORGANISATIONS 9

Leadership Styles – LMX Theory- Leadership Theory and Normative Decision Model - Situational Leadership Model - Contingency Model and Path Goal Theory – Transactional and Transformational Leadership - Charismatic Leadership – Change Management - Role of Ethics and Values in Organisational Leadership

UNIT V LEADERSHIP EFFECTIVENESS **9**

Leadership Behaviour - Assessment of Leadership Behaviors - Destructive Leadership - Motivation and Leadership – Motivation and Employee Engagement - Managerial Incompetence and Derailment Conflict Management - Negotiation and Leadership - Culture and Leadership - Global Leadership – Recent Trends in Leadership.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of managing teams for business.
2. students will understand developing effective teams for business management.
3. Students will understand the fundamentals of leadership for running a business.
4. Students will learn about the importance of leadership for business development.
5. Students will acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES

1. "Leadership and Team Building" by Uday Kumar Haldar, First Edition, Oxford University Press, New Delhi 2010.
2. "The Five Dysfunctions of a Team: A Leadership Fable" by Patrick Lencioni, 20th Anniversary Edition, Jossey-Bass 2002.
3. Hughes, R.L, Ginnett, R.C., & Curphy, G.J., Leadership: Enhancing the lessons of experience, 9th Ed, McGraw Hill Education, Chennai, India. 2019.
4. Katzenback, J.R., Smith,D.K., The Wisdom of Teams: Creating the High Performance Organisations, Harvard Business Review Press, 2015.
5. Haldar, U.K., Leadership and Team Building, Oxford University Press, 2010.

BAM203 CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP L T P C
3 0 0 3

COURSE OBJECTIVES

1. To develop the creativity skills among the learners.
2. To impart the knowledge of creative intelligence essential for entrepreneurs.
3. To impart the knowledge of Innovation in Industries.
4. To know the applications of innovation in entrepreneurship.
5. To develop innovative business models for business.

UNIT I CREATIVITY 9

Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities-Quality of Creativity-Existential, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology - Creative Personality and Motivation - Creativity Training.

UNIT II CREATIVE INTELLIGENCE 9

Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION 9

Innovation: Definition- Levels of Innovation- Incremental Vs Radical Innovation- Inbound and Outbound Ideation-Product Innovation and Process- Technological, Organizational Innovation – Indicators Characteristics of Innovation in Different Sectors. Theories in Innovation and Creativity-Design Thinking and Innovation- Innovation as Collective Change-Innovation as a system

UNIT IV INNOVATION AND ENTREPRENEURSHIP 9

Innovation and Entrepreneurship: Entrepreneurial Mindset, Motivations and Behaviours-Opportunity Analysis and Decision Making- Industry Understanding - Entrepreneurial Opportunities- Entrepreneurial Strategies – Technology Pull/Market Push – Product -Market fit

UNIT V INNOVATIVE BUSINESS MODELS 9

Innovative Business Models: Customer Discovery-Customer Segments-Prospect Theory and Developing Value Propositions- Developing Business Models: Elements of Business Models – Innovative Business Models: Elements, Designing Innovative Business Models- Responsible Innovation and Creativity.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of creativity for developing Entrepreneurship
2. Students will understand the importance of creative intelligence for business growth
3. Students will understand the advances through Innovation in Industries
4. Students will learn about applications of innovation in building successful ventures
5. Students will acquaint with developing innovative business models to run the business efficiently and effectively

REFERENCES

1. Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand & Sons, 2021.
2. Innovation Management, C.S.G. Krishnama charyulu, R. Lalitha, Himalaya Publishing House, 2nd edition, 2017.
3. Paul Trott, Innovation Management and New Product Development, 4e, Pearson, 2018.
4. A. Dale Timpe, Creativity, Jaico Publishing House, 2003. Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.
5. Tidd, J., & Bessant, J. Managing innovation: Integrating technological, market and organizational change. UK: Wiley 2020.

BAM204 PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
2. To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
3. To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.
4. To consider the various decision areas within marketing and the tools and methods used by marketing managers for making decisions.
5. To appreciate how a marketing perspective is important in your own personal and professional development.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT 9

Introduction-Market and Marketing – Concepts – Functions of Marketing - Importance of Marketing Marketing Orientations - Marketing Mix-The Traditional 4Ps - The Modern Components of the Mix The Additional 3Ps - Developing an Effective Marketing Mix.

UNIT II MARKETING ENVIRONMENT 9

Introduction-Environmental Scanning- Analysing the Organisation's Micro Environment andMacro Environment - Differences between Micro and Macro Environment – Techniques of Environment Scanning - Marketing organization - Marketing Research and the Marketing Information System, Types and Components.

UNIT III PRODUCT AND PRICING MANAGEMENT 9

Product-Meaning, Classification, Levels of Products – Product Life Cycle (PLC) - Product Strategies Product Mix - Packaging and Labelling - New Product Development - Brand and Branding - Advantages and disadvantages of branding Pricing - Factors Affecting Price Decisions - Cost Based Pricing - Value Based and Competition Based Pricing - Pricing Strategies - National and Global Pricing.

UNIT IV PROMOTION AND DISTRIBTUION MANAGEMENT 9

Introduction to Promotion – Marketing Channels- Integrated Marketing Communications (IMC) – Introduction to Advertising and Sales Promotion –Basics of Public Relations and Publicity -

Personal Selling - Process - Direct Marketing - Segmentation, Targeting and Positioning (STP)- Logistics Management- Introduction to Retailing and Wholesaling.

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT 9

Introduction - Relationship Marketing vs. Relationship Management - Customer Relationship Management (CRM) - Forms of Relationship Management - CRM practices - Managing Customer Loyalty and Development – Buyer-Seller Relationships- Buying Situations in Industrial / Business Market - Buying Roles in Industrial Marketing - Factors that Influence Business - Services Marketing, E-Marketing or Online Marketing.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will have the awareness of marketing management process.
2. Students will understand the marketing environment.
3. Students will acquaint about product and pricing strategies.
4. Students will have the knowledge of promotion and distribution in marketing management.
5. Students can comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES

1. Marketing Management, Sherlekar S.A, Himalaya Publishing House,2016.
2. Marketing Management, Philip Kotler and Kevin Lane Keller, PHI 15th Ed, 2015.
3. Marketing Management-An Indian perspective, Vijay Prakash Anand, Biztantra, Second edition, 2016.
4. Marketing Management Global Perspective, Indian Context, V.S.Ramaswamy & S.Namakumari, Macmillan Publishers India, 5th edition, 2015.
5. Marketing Management, S.H.H. Kazmi, 2013, Excel Books India.

BAM205 HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.
4. To understand the training and compensation practices in Industry
5. To create an awareness on controlling measures followed HR practitioners.

UNIT I INTRODUCTION TO HRM 9

Definition, Objectives- Nature and Scope of HRM - Evolution of HRM - HR Manager Roles- Skills - Personnel Management Vs. HRM - Human Resource Policies - HR Accounting – HR Audit - Challenges in HRM.

UNIT II HUMAN RESOURCE PLANNING 9

HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR

- Recent Trends

UNIT III RECRUITMENT AND SELECTION 9

Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources –e Recruitment - Selection Process- Selection techniques -E-Selection- Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT 9

Types of Training - On-The-Job, Off-The-Job - Training Needs Analysis – Induction and Socialisation Process - Employee Compensation - Wages and Salary Administration – Health and Social Security Measures- Green HRM Practices

UNIT V CONTROLLING HUMAN RESOURCES 9

Performance Appraisal – Types - Methods - Collective Bargaining - Grievances Redressal Methods- Employee Discipline – Promotion – Demotion - Transfer – Dismissal - Retrenchment – Union - Management Relationship - Recent Trends

TOTAL :45 PERIODS

COURSE OUTCOMES

1. Students will understand the Evolution of HRM and Challenges faced by HR Managers
2. Students will learn about the HR Planning Methods and practices.
3. Students will acquaint about the Recruitment and Selection Techniques followed in Industries.
4. Students will know about the methods of Training and Employee Development.
5. Students will comprehend the techniques of controlling human resources in organisations.

REFERENCES

1. Gary Dessler and Biju Varkkey, Human Resource Management, 14e, Pearson, 2015.
2. David A. Decenzo, Stephen.P.Robbins, and Susan L. Verhulst, Human Resource Management, Wiley, International Student Edition, 11th Edition, 2014
3. Mathis and Jackson, Human Resource Management, Cengage Learning 15e, 2017.
4. R. Wayne Mondy, Human Resource Management, Pearson, 2015.
5. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012

BAM206 FINANCING NEW BUSINESS VENTURES L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce the fundamentals of financing entrepreneurial ventures.
2. To understand the structure and avenues for debt and equity financing.
3. To explore government initiatives and institutional frameworks for start-ups.
4. To equip students with practical knowledge of fundraising processes for new ventures.
5. To develop competencies in evaluating financing strategies for new businesses.

UNIT I ESSENTIALS OF NEW BUSINESS VENTURE 9

Setting up new Business Ventures – Need - Scope - Startup Ecosystem in India-Franchising - Location Strategy, Registration Process - Legal Requirements- State Directorate of Industries- Financing for New Ventures - Central and State Government Agencies - Types of loans – Financial Institutions - SFC, IDBI, NSIC and SIDCO.

UNIT II INTRODUCTION TO VENTURE FINANCING 9

Venture Finance–Definition–Historic Background– Importance – Funding New Ventures-Need–Scope– Types – Cost of Project-Means of Financing -Estimation of Working Capital-Requirement of funds– Mix of Debt and Equity - Challenges and Opportunities.

UNIT III SOURCES OF DEBT FINANCING 9

Fund for Capital Assets - Term Loans - Leasing and Hire Purchase - Money Market instruments – Bonds, Debentures, Corporate Papers – Preference Capital- Working Capital Management- Fund based Credit Facilities - Cash Credit - Over Draft.

UNIT IV SOURCES OF EQUITY FINANCING 9

Own Capital, Unsecured Loan - Government Subsidies, Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital- Venture Valuation- meaning and Basic Mechanics of Valuation

UNIT V METHODS OF FUND RAISING FOR NEW VENTURES 9

Investor Decision Process - Identifying the appropriate investors- Targeting investors- Building Investor Relationships-Investor Selection Criteria- Company Creation-Raising Funds-Seed Funding- VC Selection Criteria – Process- Methods- VC Investment Process in India-Recent Trends

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will learn the basics of starting a new business venture.
2. Students can identify various venture financing opportunities
3. Students will understand the sources of debt financing.
4. Students will understand the sources of equity financing.
5. Students will acquaint and Formulate strategies for effective fundraising in real-world scenarios.

REFERENCES

1. Chandra, P. Projects: Planning, analysis, financing, implementation, and review (8th ed.). McGraw Hill Education, 2017.
2. Ramsinghani, M., The business of venture capital: The art of raising a fund, structuring investments, portfolio management, and exits (3rd ed.). Wiley. 2021.
3. Prasanna Chandra, Projects planning, Analysis, Selection, Financing, Implementation and Review, McGraw Hilld Education India Pvt Ltd, New Delhi, 2019.
4. Byers, Thomas. Technology Ventures: From Idea to Enterprise. McGraw – Hill Higher Education, 2014
5. Steven Rogers, Entrepreneurial Finance: Finance and Business Strategies for the Serious Entrepreneur 3e, Tata Mc Graw Hill, 2014.

BAM301	PRINCIPLES OF PUBLIC ADMINISTRATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To understand the nature, scope and essentials of Public Administra administrative theories and concepts to make sense of administrative practices
2. To evaluate the changing paradigms of Public Administration.
3. To understand the synthesizing knowledge of public administration from pu perspective.
4. To study and explore the approaches of administrative process.
5. To cover the principles, practices and the impact of public administration on soci

UNIT I INTRODUCTION TO PUBLIC ADMINISTRATION 9

Meaning- Nature and Scope of Public Administration, Evolution of Public Administrati Public Administration and Private Administration, Public Administration –Arts, Science both, Public Administration - relations to other social sciences, Importance of Public Administration.

UNIT II EMERGING TRENDS IN PUBLIC ADMINISTRATION 9

New Public Administration–Formulating the structure, New Public Management,

Globalization and Public Administration, Paradigm Shift from Government to Governar

UNIT III ADMINISTRATIVE ORGANIZATIONS 9

Forms of Administrative Organizations –Departments, Public Corporations, Public sector undertakings, Independent Regulatory Commissions, Line and Staff Agencies, Administrative Tribunal.

UNIT IV APPROACHES AND THEORIES OF PUBLIC ADMINISTRATION 9

Classical Approach, Administrative Approach, Scientific ManagementApproach, Bureaucratic Approach, Human Relations Approach, Ecological Approach.

UNIT V PRINCIPLES AND PRACTICES OF PUBLIC ADMINISTRATION 9

Chief Executive - Meaning, Types, Functions & Qualities of Chief Execut Supervision, Communication - meaning, types of communication &

its importance in Public Administration, Centralization & Decentralization, Public Relation, Meaning,Methods & Significance, Decision making - Types, Techniques and Processes, Leadership - Styles –Approaches.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Students will understand public administration theory and concepts from multiple perspectives.
2. Students will appreciate the nature, scope and dynamics of Public Administration.
3. Students will acquaint with India's development experience and changing role of administration practices.
4. Students will grasp the administrative theories, concepts and principles to make sense of administration in the developing era.
5. Students will demonstrate the integrative knowledge, skills and ethics necessary for responsible Administrative, management and leadership positions.

REFERENCES

1. Lakshmi Kanth ,Public Administration by McGraw Hill,2018
2. Rosenbloom David, Public Administration: Understanding Managem Politics, and Law in the Public Sector, McGraw Hill, 2018.
3. Avasthi and Maheswari: Public Administration in India, Agra:Lak Narain Agarwal,2013.
4. Ramesh K Arora: Indian Public Administration, New Delhi: Wis Prakashan, 2012.
5. R.B. Jain: Public Administration in India,21st Century Challenges Good Governance, New Delhi: Deep and Deep, 2002.

BAM302 CONSTITUTION OF INDIA L T P C
3 0 0 3

COURSE OBJECTIVES

1. To know about the basic structure of Indian Constitution, Fundamental Rights(FR's), DPSP's and Fundamental Duties (FD's) of our constitution.
2. To know about the functioning of three wings of the government i.e., executive, legislative and judiciary.
3. To know the State Executive s Union territories.
4. To know about the Local Administration from Corporation to Village Level.
5. To learn the pattern of Election systems and concept of E-Governance.

UNIT I INTRODUCTION 9

Meaning of the Constitution Law and Constitutionalism - Constituent Assembly. Government of India Act of 1935 and Indian Independence Act of 1947 – Enforcement of COI and its Salient Features – Why Tamilnadu's "Sengol" in Parliament (1947 & 2023)- Samvidhan Divas - The Preamble. The Constitutional amendments in India - National Emergency, President Rule, Financial Emergency - Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT II THE CENTRE: EXECUTIVE, LEGISLATIVE AND JUDICIARY 9

Meaning of Indian Flag & Ashoka Chakra. Indian Parliament – RS - LS – Power & Functions. Honourable "The President" & "The Vice President", "The Prime Minister" - Power &Functions - Comparison of Indian President with the United States - Central Ministry of Council. The Independence of the Supreme Court - Appointment of Supreme & High Courts Judges (Collegium) - Judicial Review, Judicial Activism, and PIL -, The Lokpal & Lok Ayuktas 2013 – NRC & CAA (Illegal Migrants) - Abrogation of Article 370 in J & K – Need of Uniform Civil Code.

UNIT III THE STATE GOVERNMENT, UNION TERRITORIES STATE LEGISLATURE 9

Madras Presidency to Tamil Nadu – Tamil Nadu Emblem. State Executives – His Excellency "The Governor"Power & Functions, Chief Minister – Power & Functions, State Cabinet, Members of Legislative AssemblyRole. Union Territories – Power & Functions. Federal System, Centre-State Relations. High Court & Subordinate Courts- Lok Adalat 1982 Vs Arbitration Tribunal.

UNIT IV LOCAL ADMINISTRATION 9

Corporation – Mayor, Chairman District Administration Head - Role and Importance, Role of Elected Representative – Pachayati Raj: Functions PRI – Grama Sabha. Block level Organizational Hierarchy, Village level - Role of Elected and Appointed officials - Importance of grass-root democracy.

UNIT V ELECTION SYSTEMS AND E-GOVERNANCE 9

Election Commission: Role of Chief Election Commissioner - State Election Commission – One India One Election. National Good Governance Day - Governance and role of Engineers in E-Governance, Need for reformed engineering serving at the Centre and State, E- Courts, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will identify and explore the basic features and modalities about Indian constitution.
2. Students will differentiate and relate the functioning of 3 wings of India.
3. Students will understand the state level executives and state courts
4. Students will identify the role of Mayor and elected representatives of Municipalities
5. Students will know the role of Election Commission apply knowledge and E-governance.

REFERENCES

1. BR. Ambedkar, Rupa Publications. The Constitution of India. Rupa Publications. 2024.
2. Singh, M. P. (Ed.). EBC's V. N. Shukla's Constitution of India (14th ed., reprint 2024). Eastern Book Company.
3. Bakshi, P. M The Constitution of India (19th ed.). Universal Law Publishing (LexisNexis) 2023.
4. Babu, D. D. Introduction to the Constitution of India (27th ed.). Lexis Nexis 2024.
5. Sharma, B. K. Introduction to the Constitution of India (11th ed.). PHI Learning 2024.

BAM303	PUBLIC PERSONNEL ADMINISTRATION	L T P C
		3 0 0 3

COURSE OBJECTIVES

1. To understand the fundamental principles, scope, and evolution of Public Personnel Administration.
2. To analyze different types of personnel systems and their relevance in democratic governance.
3. To examine the processes of recruitment, training and promotion within the public sector.
4. To gain insights into the structure and functioning of All India Services and State Public Service Commissions.
5. To evaluate employer-employee relations, wage systems and benefits in the context of public sector employment.

UNIT I INTRODUCTION TO PERSONNEL ADMINISTRATION 9

Meaning, Scope and Importance of Personnel Administration - Evolution of Public Personnel Administration-Personnel Administration vs. Human Resource Management – Challenges in Personnel Administration – Types of Personnel Systems Bureaucratic, Democratic and Representative systems- Emerging Trends in Personnel Administration.

UNIT II PERSONNEL SYSTEMS AND ADMINISTRATIVE ETHICS 9

Generalist Vs Specialist – Comparative Analysis of Personnel Systems – Role of Civil Servants in Policy Implementation - Relationship between Civil Servants and Political Executives - Mechanisms for Promoting Administrative Accountability- Civil Servant's Relationship with Political Executive – Ethics and Integrity in Administration - Mechanisms for Promoting Administrative Accountability.

UNIT III RECRUITMENT, TRAINING AND PROMOTION 9

Recruitment: Direct Recruitment and Recruitment from Within – Methods of Manpower Planning- Training: Objectives and Need –Types of Training: Induction, In-service, Orientation, Refresher - Performance Appraisal and Merit-based Promotion – Promotion.

UNIT IV PUBLIC SERVICE FRAMEWORK IN INDIA **9**

All India Services – Structure and Cadre Management – Rules and Regulations Governing Service Conditions – Code of Conduct and Disciplinary Actions –State Public Service Commissions: Functions and Autonomy - UPSC and Its Constitutional Mandate - Reservation Policy in Services - Gender Sensitization and Inclusivity in Services.

UNIT V EMPLOYEE RELATIONS AND COMPENSATIONS **9**

Employer Employee Relations – Wage Theories and Compensation Models – Principles of Pay Fixation -Salary Structures in Indian Civil Services –Salary Structures in Indian Civil Services –Social Security Benefits and Retirement Schemes - Wage and Salary Administration – Allowances and Benefits

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will demonstrate a comprehensive understanding of the nature, scope, and importance of public personnel administration
2. Students will be able to distinguish between bureaucratic, democratic, and representative personnel systems in public administration.
3. Students will apply knowledge of recruitment, training and promotion practices to real-world administrative scenarios.
4. Students will critically analyze the structure and functioning of the All India Services and State Public Service Commissions.
5. Students will evaluate wage and salary administration, allowances and employee relations within the framework of public sector employment.

REFERENCES

1. Public Personnel Administration, 6th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2015.
2. Personnel Management in Government, 7th Ed, by R. Wayne Boss 2016.
3. Human Resource Management in Public Service, 5th Ed, by Richard C. Kearney, Jerrell D. Coggburn 2015.
4. Public Administration: An Introduction, 12th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2019.
5. Public Personnel Management, 4th Ed, by Donald E. Klingner, John

Nalbandian 2018

BAM304 ADMINISTRATIVE THEORIES L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce students to the evolution of administrative thought
2. To study the contributions of key administrative thinkers
3. To develop an understanding of leadership, governance, and management principles
4. To relate classical theories to contemporary administrative practices
5. To enhance analytical and critical thinking skills

UNIT I INTRODUCTION TO PUBLIC ADMINISTRATION 9

Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a discipline and Identity of Public Administration. Public Administration - Introduction, Principles of Organization and Management, Public Policy and Governance, Administrative Structure in India, Ethics and Accountability in Public Administration, Technology and Public Administration, Contemporary Issues in Public Administration.

UNIT II THEORIES OF ORGANIZATION 9

Theories of Organization: Scientific Management Theory, Classical Model, Human Relations Theory. Introduction to Organizations, Neo-Classical Theories, Modern Theories, Contemporary Approaches, Organization Design and Structure, Leadership and Motivation in Organizations, Applications to Modern Industry and Technology.

UNIT III ORGANIZATIONAL BEHAVIOUR AND DESIGN 9

Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design. Organizational Behaviour - Introduction, Individual Behaviour in Organizations, Group Behaviour and Team Dynamics, Leadership and Power, Conflict and Negotiation, Organizational Culture and Climate, Organizational Change and Development, Contemporary Issues in OB.

UNIT IV MOTIVATION AND LEADERSHIP 9

Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and Modern: Process and techniques of decision-making Motivation -

Definition and Importance, Content Theories, Process Theories. Leadership - Meaning, Roles, and Importance of Leadership, Leadership Theories. Decision Making - Nature and Types of Decisions, Decision-Making Process: Steps and Models. Contemporary Perspectives, Applications and Case Studies.

UNIT V ADMINISTRATIVE THINKERS 9

Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard. Peter Drucker Introduction to Administrative Thought, Kautilya (Chanakya) - Arthashastra: Concepts of Governance and Statecraft. Woodrow Wilson - The Study of Administration as a discipline. Chester I. Barnard - The Functions of the Executive, Concept of Formal and Informal Organizations, Peter F. Drucker - Management by Objectives (MBO), Comparing Key Contributions: Classical vs Modern Perspectives. Administrative Principles in Startups, Tech Companies, and Government Projects.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will understand foundational ideas of administration
2. Students will be able to analyze different administrative and management theories
3. Students will apply classical principles to modern contexts
4. Students will be able to evaluate the role of leadership and ethics in administration
5. Students will develop problem-solving skills using administrative models

REFERENCES

1. R. K. Sapru – Administrative Theories & Management Thought, 3rd Edition, 2013
2. “Public Administration Theories & Principles” (Vidya R., Rajaram), Kindle 2024 Edition
3. Fernando Lunenburg & Allen Irby – included in Development of Administrative Theory, SAGE Publications 2022
4. Global Encyclopedia of Public Administration, Public Policy, and Governance. Springer Publications, 2nd Edition, 2020
5. Administrative Theories: Approaches, Concepts and Thinkers in Public Administration, Rakesh Hooja, Ramesh K Arora 2007

BAM305 INDIANADMINISTRATIVESYSTEM L T P C

3 0 0 3

COURSE OBJECTIVES

1. To understand the historical evolution and constitutional framework of Indian administration.
2. To analyze the role and functioning of key constitutional authorities and administrative institutions.
3. To explore the structure, functions, and challenges of local governance and grassroots administration.
4. To examine the impact of coalition politics and the role of ethics in administrative integrity
5. To evaluate the mechanisms for corruption control, including Ombudsman, Lokpal & Lok Ayukta.

UNIT I INTRODUCTION TO INDIAN ADMINISTRATION 9

Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India, Separation of powers and checks & balances in governance

UNIT II LOCAL GOVERNMENT AND ADMINISTRATION 9

Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government, Role of Smart Cities & Urban Local Bodies in governance

UNIT III CONSTITUTIONAL AMENDMENTS 9

Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992, Implementation challenges and success stories of decentralized governance, Case studies on local governance reforms

UNIT IV POLITICS AND ETHICS 9

Coalition politics in India, Integrity and Vigilance in Indian Administration, Role of transparency and accountability in governance (RTI Act, Citizen Charters), Ethical

dilemmas in civil services and administrative ethics.

UNIT V TECHNOLOGY IN ADMINISTRATION 9

Corruption–Ombudsman, Lokpal & Lok Ayuktha, Recent anti-corruption measures (Whistle blower Protection Act, Black Money laws), Digital governance and technology-driven transparency in administration

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will gain a comprehensive understanding of India's administrative system, governance structure, and reforms.
2. They will be able to critically assess the functioning of constitutional authorities and their influence on policymaking
3. Learners will develop the ability to analyze local governance models and propose solutions for administrative challenges.
4. They will demonstrate awareness of political dynamics, ethics, and accountability in governance.
5. Graduates will be equipped to evaluate anti-corruption measures and suggest improvements for transparent administration.

REFERENCES

1. S.R. Maheswari : Indian Administration - Orient Black Swan, Sixth edition, 2001
2. In dian Public Administration: Institutions and Issues by Rajni Arora & Ramesh K. Goyal - New Age International Publishers, Fourth edition, 2022
3. Indian Administration - Evolution and Practice by Bidyut Chakrabarty – SAGE Publications India Pvt, Ltd. First edition,2019
4. Khera. S.S : Administration in India – Asia Publishing House, Bombay, First edition,1964
5. Ramesh K. Arora : Indian Public Administration - New Age International Publishers, Fourth edition, 2022

BAM306 PUBLIC POLICY ADMINISTRATION L T P C
3 0 0 3

COURSE OBJECTIVES

1. To provide students with a comprehensive understanding of the meaning, nature, scope, and significance of public policy..
2. To equip students with knowledge of various approaches to policy analysis and familiarize them with key models such as Dror's Optimal Model.
3. To enable students to understand the stages of the policy-making process, including formulation, implementation, and evaluation.
4. To analyze the role of institutions, bureaucracy, interest groups, and political parties in the public policy process.
5. To introduce students to significant public policies in India, such as the New Economic Policy, Population Policy, Agricultural Policy, and Information Technology Policy.

UNIT I INTRODUCTION TO PUBLIC POLICY 9

Meaning and Definition of Public Policy - Nature, Scope and Importance of public policy – Public policy relationship with social sciences especially with political science and Public Administration – Importance and relevance of public policy in modern society.

UNIT II POLICY APPROACHES 9

Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System's Approach – Dror's Optimal Model- Comparison of different approaches.

UNIT III POLICY FRAMEWORK 9

Major stages involved in Policy making Process – Policy Formulation – Policy Implementation – Policy Evaluation – Feedback mechanism and Policy change.

UNIT IV ROLE OF POLITICS IN POLICY FRAMEWORK 9

Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties – Role of Judiciary.

UNIT V TECHNOLOGY IN POLICY FRAMEWORK **9**

Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy – Digital India Initiative.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to know the importance of public policy and its interdisciplinary connections, especially with political science and public administration.
2. Students can able to assess different approaches and models used in policy analysis, including institutional, incremental, systems approaches, and Dror's Optimal Model.
3. Students will understand the stages involved in the policy-making process, from formulation through to evaluation.
4. Students can able to analyze the institutional framework and the roles played by bureaucracy, political parties, and interest groups in policy-making.
5. Students can able to evaluate the key public policies in India, understanding their context, objectives, and impacts.

REFERENCES

1. Anderson, J. E., Moyer, J., & Chichirau, G. Public Policymaking: An Introduction (9th ed.). New Delhi, India: Cengage India 2023.
2. Bardach, E., & Patashnik, E. M. A Practical Guide for Policy Analysis: The Eightfold Path to More Effective Problem Solving (7th ed.). Washington, DC: CQ Press 2023.
3. Cairney, P. Understanding Public Policy: Theories and Issues (2nd ed.). London: Bloomsbury Academic 2024.
4. Kraft, M. E., & Furlong, S. R. (Public Policy: Politics, Analysis, and Alternatives (8th ed.). Thousand Oaks, CA: CQ Press 2023.
5. Smith, K. B., & Larimer, C. W. The Public Policy Theory Primer (3rd ed.). New York, NY: Routledge 2017.

VERTICAL 4: BUSINESS DATA ANALYTICS

BAM401 STATISTICS FOR MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES

1. To apply statistical methods to analyze engineering and management problems.
2. To use descriptive statistics and probability theory to summarize, interpret, and present engineering and business data effectively.
3. To employ inferential statistical tools such as hypothesis testing, confidence intervals, and regression analysis to solve real-world management and engineering problems.
4. To utilize statistical software/tools to perform data analysis and interpret output for strategic planning, quality control, and operational efficiency.
5. To develop problem-solving skills by applying statistical reasoning to project management, production processes, and optimization in engineering enterprises.

UNIT I INTRODUCTION **9**

Concepts of Experiment, Event, Sample Space, Basic definitions and addition and multiplication rules for probability, Baye's theorem and random variables, Importance of Statistics in Business and Engineering, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION **9**

Introduction to Sampling, Population vs. Sample, Concept of a Sampling Distribution, Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters. Confidence Interval for the Mean (Known and Unknown Population Variance)

UNIT III TESTING OF HYPOTHESIS - PARAMETRIC TESTS **9**

Introduction to Hypothesis Testing - Definition and Importance of Hypothesis Testing in Engineering and Business, Basic Concepts: Null Hypothesis (H_0), Alternative Hypothesis (H_1), Type I and Type II Errors, Significance Level (α) and Power of a Test, p-Value: Concept and Interpretation. Parametric Tests for Mean

(t-test), Parametric Tests for Proportions (Z-test), Analysis of Variance (ANOVA).

UNIT IV TESTING OF HYPOTHESIS - NON-PARAMETRIC TESTS **9**

Introduction to Non-Parametric Tests, Differences Between Parametric and Non-Parametric Tests, Sign Test (Concept of the Sign Test for One-Sample Data), Mann-Whitney U Test (Wilcoxon Rank-Sum Test), Wilcoxon Signed-Rank Test (Testing Differences for Paired Data), Kruskal- Wallis H Test (Testing for Differences Between More Than Two Independent Groups), Chi- Square Test for Goodness of Fit (Goodness of Fit Test, Test for Independence, Analyzing Relationships Between Categorical Variables), Friedman Test (Non-Parametric Test for Comparing More Than Two Related Groups).

UNIT V CORRELATION AND REGRESSION **9**

Introduction to Correlation and Regression, Correlation Analysis - Pearson's Correlation Coefficient (r), Spearman's Rank Correlation. Simple Linear Regression - Introduction to Regression Analysis, Simple Linear Model, Multiple Linear Regression, Applications of Correlation and Regression in Engineering - Quality Control and Six Sigma, Reliability Engineering, Optimization Problems.

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will be able to facilitate objective solutions in business decision making.
2. Students will understand and solve business problems.
3. Students will apply statistical techniques to data sets, and correctly interpret the results.
4. Students will develop skill-set that is in demand in both the research and business environments.
5. Students will be able to apply the statistical techniques in a work setting.

REFERENCES

1. Richard I. Levin, David S. Rubin, Masood H Siddiqui, Sanjay Rastogi, Statistics for Management, Pearson Education, 8th Edition, 2017.
2. Fundamentals of Mathematical Statistics, by S.C. Gupta and V.K. Kapoor Revised Edition 2020.

3. Prem. S. Mann, Introductory Statistics, Wiley Publications, 9th Edition, 2015.
4. T N Srivastava and Shailaja Rego, Statistics for Management, Tata McGraw Hill, 3rd Edition 2017.
5. Ken Black, Applied Business Statistics, 7th Edition, Wiley India Edition, 2012.

BAM402 DATA MINING FOR BUSINESS INTELLIGENCE L T P C
3 0 0 3

COURSE OBJECTIVES

1. To familiarize students with the fundamental principles and scope of datamining and business intelligence.
2. To develop an understanding of data preparation and data quality issues in business analytics.
3. To explain key datamining techniques such as classification, clustering, and association rule mining from a business view point.
4. To expose students to the practical applications of datamining in various business functions.
5. To sensitize students to the ethical, strategic and managerial implications of using datamining for decision-making.

UNIT I INTRODUCTION TO DATAMINING AND BUSINESS INTELLIGENCE 9

Data Mining – Definition – Purpose – Role in Business Intelligence – Scope – Importance in Managerial Decision-Making – Difference between Data Mining and Business Analytics – Knowledge Discovery in Databases (KDD) – CRISP – DM Methodology – Phases of Data Mining Process – Applications in Business – Benefits and Limitations – Organizational Challenges in Data Mining Implementation.

UNIT II DATA PREPARATION AND DATA UNDERSTANDING 9

Types and Sources of Business Data – Structured and Unstructured Data– Importance of Data Quality – Data Cleaning and Handling Missing Values – Data Normalization and Transformation – Exploratory Data Analysis (EDA) – Descriptive Statistics – Frequency Distributions–Data Visualization Techniques–Graphs and Charts–Use of Dashboards for Business Insights – Role of EDA in Business Decision-Making.

UNIT III CORE DATA MINING TECHNIQUES 9

Overview of Data Mining Techniques – Classification – Concept and Applications – Decision Trees – Logistic Regression – Business Use Cases – Clustering – Concept and Business Use –Customer Segmentation – Behavioral Grouping – Association Rule Mining – Market Basket Analysis– Support, Confidence and Lift – Interpretation of Rules – Use in Retail and Marketing–Non- Technical Overview of Techniques.

UNIT IV FUNCTIONAL APPLICATIONS OF DATA MINING IN BUSINESS 9

Applications in Marketing–Customer Profiling–Targeted Campaigns– Churn Prediction– Applications in Finance – Risk Assessment – Credit Scoring – Fraud Detection – Applications in HR – Employee Attrition – Workforce Analytics – Applications in Operations–Demand Forecasting – Inventory Optimization – Vendor Analysis – Real-Life Business Use Cases – Managerial Interpretation of Results.

UNIT V MANAGERIAL PERSPECTIVES, ETHICS AND EMERGING TRENDS 9

Managerial Role in Business Intelligence – Framing Business Problems – Interpretation of Data Mining Results – Reporting and Communication of Insights – Ethical Issues – Data Privacy – Consent – Algorithmic Bias – Transparency – Recent Trends – Self–Service BI–Real- Time Analytics – Augmented Intelligence – Role of Managers in Promoting Data-Driven Culture–Challenges and Future Opportunities.

COURSE OUTCOMES

1. Students will be able to explain the core concepts and process models used in data mining and business intelligence.
2. Students will recognize the importance of data quality, organization and visualization in deriving insights.
3. Students will be able to interpret the basic logic of classification, clustering, and association rules with practical business examples
4. Students will be able to apply conceptual knowledge of datamining techniques to functional business problems.
5. Students will be able to evaluate the role of ethics, managerial insight and business context in the implementation of data-driven strategies.

REFERENCES

1. Galit Shmueli, Nitin R. Patel, and Peter C. Bruce, Data Mining for Business Analytics: Concepts, Techniques, and Applications with XL Miner, 3rd Edition, 2016, Wiley.
2. U Dinesh Kumar, Business Analytics: The Science of Data – Driven Decision Making, 2nd Edition,2020, Wiley India Pvt. Ltd.
3. V. Rameshand K.N. Prasad, Data Mining and Data Warehousing, 2nd Edition,2020, Wiley India Pvt. Ltd.
4. V.P Jain, Data Mining Techniques for Marketing, Sales, and Customer Relationship Management,1st Edition,2016, BPB Publications.
5. Anil Maheshwari, Data Analytics Made Accessible, 2nd Edition, 2017, Amazon Digital Services LLC.

BAM403 HUMAN RESOURCE ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
2. To know the different types of HR metrics and understand their respective impact and application.
3. To understand the impact and use of HR metrics and their connection with HR analytics.
4. To understand common work force issues and resolving the musing people analytics.
5. The learners will be conversant about HR metrics and ready to apply at work settings.

UNIT I INTRODUCTION TO HR ANALYTICS 9

HR analytics - People Analytics: Definition- context - stages of maturity - Human Capital in the Value Chain: impact on business. HR Analytics vs HR Metrics – HR metrics and KPIs.

UNIT II HR ANALYTICS I: RECRUITMENT 9

Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio- Quality of hire- Recruitment to HR cost - Recruitment analysis.

UNIT III HR ANALYTICS II: TRAINING AND DEVELOPMENT 9

Training & Development Metrics: Percentage of employee trained- Internally and externally trained-Training hours and cost per employee - ROI -Optimising the ROI of HR Programs - Training and Development analysis.

UNIT IV HR ANALYTICS III: EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION 9

Employee Engagement Metrics: Talent Retention - Retention index - Voluntary and involuntary turnover- Turnover by department, grades, performance, and service tenure - Internal hired index - Engagement Survey Analysis. Career Progression Metrics : Promotion index - Rotation index - Career path index - Level wise succession readiness index.

UNIT V HR ANALYTICS IV: WORK FORCE DIVERSITY AND DEVELOPMENT 9

Workforce Diversity and Development Metrics: Employees per manager - Workforce age

profiling - Workforce service profiling- Churn over index - Workforce diversity index -

Gender mix - Differently abled index- Revenue per employee – Operating cost per employee - PBT per employee - HR cost per employee- HR budget variance - Compensation to HR cost.

TOTAL:45 PERIODS

COURSE OUTCOMES

1. Students will be conversant about HR metrics and ready to apply at work settings.
2. Students will be able to resolve HR issues using people analytics**.**
3. Students will gain knowledge about analytics of training and development.
4. Students will know about the analytics of employee engagement and career progression
5. Students are competent in the analytics of work force diversity and development.

REFERENCES

1. Ferrar, J., & Green, D. Excellence in People Analytics: How to Use Data to Create Value and Drive Business Success (2nd ed.). Kogan Page. 2021.
2. Soundararajan, R., & Singh, K. Winning on HR Analytics: Leveraging Data for Competitive Advantage. SAGE Publications Pvt. Ltd. 2022.
3. Edwards, M. R., Minbaeva, D., Levenson, A., &Huselid, M. A. (Eds.). Workforce Analytics: A Global Perspective. Routledge. 2023.
4. Jang, D., Edwards, M., & Edwards, K. Using R in HR Analytics. Kogan Page 2023.
5. Lochab, A., Duhan, P., &Dangi, H.K. HR Analytics: Concepts and Applications. S. Chand Publishing.

BAM404 MARKETING AND SOCIAL MEDIA WEB ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To showcase today's opportunities to leverage the power of marketing on the web and social media through web analytics.
2. Understand the role of social media web analytics within the digital marketing landscape.
3. Identify, define, and interpret commonly used web metrics and KPIs.
4. Understand analytical methods to transform social media data into marketing insights.
5. Understand the process of search engine optimization and the search behaviors of customers.

UNIT I MARKETING ANALYTICS 9

Introduction to Marketing Analytics - Marketing Budget and Marketing Performance Measure, Marketing Metrics and Its Applications - Financial Implications of Various Marketing Strategies- Geographical Mapping, Data Exploration, Market Basket Analysis.

UNIT II COMMUNITY BUILDING AND MANAGEMENT 9

The History and Evolution of Social Media, Understanding the Science of Social Media, Goals for Using Social Media, Social Media Audience and Influencers, Keys to Community Building, Promoting Social Media Pages, Linking Social Media Accounts, The Viral Impact of Social Media, and Social Media as a Business.

UNIT III SOCIAL MEDIA POLICIES AND MEASUREMENTS 9

Social Media Policies-Etiquette, Privacy- Ethical Problems Posed by Emerging Social Media Technologies - The Basics of Tracking Social Media. - Social Media Analytics- Insights Gained from Social Media- Customized Campaign Performance Reports - Observations of Social Media Use.

UNIT IV WEB ANALYTICS 9

Web Analytics—Present and Future—Data Collection—Importance and Options, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of A Successful Web Analytics Strategy, Web Analytics Fundamentals, Concepts, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS 9

Search Engine Optimization (SEO), User Engagement, User-Generated Content, Web Traffic Analysis, Navigation, Usability, Eye Tracking, Online Security and Ethics, Content Management System, Data Visualization. RSS Feeds, Mobile Platforms, Understanding Search Behaviors.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. The students will understand Marketing in Social Media, Web, and Social Media Analytics and their Potential Impact.
2. The students will be able to enhance their social media marketing skills.
3. The students can develop a mass communication strategy and guide marketing campaigns.
4. The students will understand the fundamentals and concepts of web analytics.
5. The students will learn to use the resulting insights effectively to support website design decisions, campaign optimisation, search analytics, etc.

REFERENCES

1. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013.
2. Christian Fuchs, Social Media: A Critical Introduction, Sage Publications Ltd, 2014.
3. Bittu Kumar, Social Networking, V & S Publishers, 2013.
4. Avinash Kaushik, Web Analytics - An Hour A Day, Wiley Publishing, 2007.
5. Ric T. Peterson, Web Analytics Demystified, Celilo Group Media And Cafepress 2004.

BAM405 OPERATION AND SUPPLY CHAIN ANALYTICS L T P C
3 0 0 3

COURSE OBJECTIVES

1. To introduce students to the foundational concepts of analytics and their strategic role in transforming supply chains using descriptive, predictive, and prescriptive methods.
2. To equip learners with quantitative tools for warehousing decisions, including mathematical programming and heuristic methods for facility layout and space optimization.
3. To develop an in-depth understanding of inventory management techniques, emphasizing risk analysis, aggregation models, and multi-echelon planning.
4. To provide analytical skills to model and solve complex transportation and distribution network problems using graph theory, flow models, and routing algorithms.
5. To enable application of Multi-Criteria Decision-Making (MCDM) techniques such as AHP, DEA, and TOPSIS in supply chain decision scenarios.

UNIT I INTRODUCTION 9

Introduction to analytics – descriptive, predictive, and prescriptive analytics, Data-driven supply chains, Road map for data-driven supply chains. Transforming supply chains, Barriers to implementation of supply chain strategies.

UNIT II WAREHOUSING DECISIONS 9

Mathematical programming models - P-median methods - Guided LP approach - Balmer–Wolfe method, Greedy drop heuristics, Dynamic location models, Space determination and layout methods.

UNIT III INVENTORY MANAGEMENT 9

Inventory aggregation models - Dynamic lot sizing methods, Multi-echelon inventory models, Aggregate inventory system and limit, Risk analysis in the supply chain - Measuring transit risks, Supply risks, Delivering risks, and risk pooling strategies.

UNIT IV TRANSPORTATION NETWORK MODELS 9

The notion of graphs, Minimal spanning trees, Shortest path algorithms, Maximal flow problems, Multistage transhipments, and transportation problems, Set covering

and set partitioning problems, Traveling salesman algorithms, and deficit function approach, Scheduling Algorithms.

UNIT V – MCDM MODELS **9**

Multi-Criteria Decision-Making (MCDM) Techniques, Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the Analytical Network Process (ANP), TOPSIS-Application in SCM.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will understand and explain the concepts of descriptive, predictive, and prescriptive analytics and their role in enhancing data-driven supply chain decision-making.
2. Students will apply mathematical programming and heuristic methods such as P-median, Guided LP, and Greedy Drop techniques to make effective warehousing and location decisions.
3. Students will analyze and manage inventory using aggregation models, multi-echelon systems, and risk pooling strategies to improve supply chain resilience and efficiency.
4. Students will solve transportation network problems using graph-based algorithms like shortest path, maximal flow, and traveling salesman models to optimize logistics performance.
5. Students will evaluate complex supply chain scenarios using Multi-Criteria Decision-Making (MCDM) techniques such as AHP, DEA, TOPSIS, and fuzzy logic for better strategic decision- Making.

REFERENCES

1. Nada R. Sanders, Big data driven supply chain management: A framework for implementing analytics and turning information into intelligence, Pearson Education, 2014.
2. Michael Watson, Sara Lewis, Peter Cacioppi, Jay Jayaraman, Supply Chain Network Design: Applying Optimization and Analytics to the Global Supply Chain, Pearson Education, 2013.

3. Anna Nagurney, Min Yu, Amir H. Masoumi, Ladimer S. Nagurney, Networks Against Time: Supply Chain Analytics for Perishable Products, Springer, 2013.
4. Muthu Mathirajan, Chandrasekharan Rajendran, Sowmyanarayanan Sadagopan, Arunachalam Ravindran, Parasuram Balasubramanian, Analytics in Operations/Supply Chain Management , I.K. International Publishing House Pvt. Ltd., 2016.
5. Gerhard J. Plenert, Supply Chain Optimization through Segmentation and Analytics, CRC Press, Taylor & Francis Group, 2014.

BAM406 FINANCIAL ANALYTICS **L T P C**
3 0 0 3

COURSE OBJECTIVES

1. To introduce fundamental financial concepts and decision-making techniques relevant to corporate finance.
2. To familiarize students with the basics of financial markets and time-series analysis techniques for estimating risk and return.
3. To provide insights into portfolio theory and option pricing models used for investment analysis.
4. To expose students to basic technical indicators and simulation strategies for analyzing stock market behavior.
5. To enable students to understand and apply basic credit risk models using statistical and machine learning techniques.

UNIT I FOUNDATIONS OF CORPORATE FINANCIAL ANALYSIS **9**

Introduction to financial analytics. Basic financial models – Time value of money, cash flow analysis, cost of capital. Project appraisal methods – Payback period, NPV, IRR. Capital budgeting and financial break-even analysis.

UNIT II FINANCIAL MARKET DATA AND TIME-SERIES ANALYSIS **9**

Introduction to financial market instruments – Stocks and Bonds. Basics of risk and return. Overview of financial data and Time-Series characteristics. Introduction to Value at Risk (VaR). Basics of Auto Regressive Moving Average (ARMA), Autoregressive Conditional Heteroscedasticity (ARCH), and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models for volatility forecasting.

UNIT III PORTFOLIO THEORY AND DERIVATIVES **9**

Portfolio diversification and risk-return trade-off. Capital Asset Pricing Model (CAPM). Sharpe ratio. Option pricing basics – Binomial model, Black-Scholes model. Implied volatility and option strategies.

UNIT IV TECHNICAL ANALYSIS AND TRADING SIMULATIONS **9**

Overview of technical indicators – Relative Strength Index (RSI), Moving Average Convergence Divergence (MACD), Rate of Change (ROC), Moving Averages,

Candlestick patterns. Simulation of basic trading strategies. Introduction to algorithmic trading concepts. Prediction of stock prices using chart patterns.

UNIT V CREDIT RISK ANALYTICS **9**

Introduction to credit risk. Data pre-processing for credit modelling. Logistic regression, decision trees, and model evaluation techniques. Application of analytics in credit scoring and loan approvals, and evaluating credit risk model.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students will apply core financial concepts to evaluate corporate investment decisions using tools like NPV and IRR.
2. Students will analyze risk and return using financial time-series models and interpret key market indicators.
3. Students can able to construct and assess investment portfolios and derivative strategies using theoretical models.
4. Students will use basic technical analysis indicators and simulate simple trading strategies.
5. Students can develop and evaluate credit risk models using statistical methods like logistic regression and decision trees.

REFERENCES

1. Mark J. Bennett, Dirk L. Hugen, "Financial Analytics with R: Building a Laptop Laboratory for Data Science", Cambridge University Press, 1st Edition, 2016.
2. Pavel Ryzhov, "Haskell Financial Data Modeling and Predictive Analytics", Packt Publishing, 1st Edition, 2013.
3. Edward E. Williams, John A. Dobelman, "Quantitative Financial Analytics: The Path to Investment Profits", World Scientific Publishing, 1st Edition, 2017.
4. Yuxing Yan, "Python for Finance – Second Edition: Apply Powerful Finance Models and Quantitative Analysis with Python", Packt Publishing, 2nd Edition, 2017.
5. James Ma Weiming, "Mastering Python for Finance – Second Edition: Implement Advanced State-of-the-Art Financial Statistical Applications Using Python", Packt Publishing, 2nd Edition, 2019.

VERTICAL - V

AGM501	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge about sustainable Infrastructure development goals.
- To practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.
- To understand how infrastructure projects are conceptualised and planned and the project lifecycle phases
- To learn concepts related to infrastructure economics and finance, including various project feasibility models
- To understand and assess the use of various risk management processes and practices in the context of infrastructure projects

UNIT- I SUSTAINABLE DEVELOPMENT GOALS 9

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian — Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands — Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian — Infrastructure Project finance — Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

UNIT- II SUSTAINABLE INFRASTRUCTURE PLANNING 9

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement &Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning — Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

UNIT- III SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES **9**

Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction — Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT- IV SUSTAINABLE CONSTRUCTION MATERIALS **9**

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption – Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility — Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies –Design for Disassembly - Dematerialization, rematerialization, transmaterialization — Green procurement and green distribution - Analysis framework for reuse and recycling – Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations — Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC — Case studies.

UNIT- V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS **9**

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the

Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. — Use of Emerging Technologies — IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the environment sustainability goals at global and Indian scenario.
2. Understand risks in development of projects and suggest mitigation measures.
3. Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
4. Explain Life Cycle Analysis and life cycle cost of construction materials.
5. Explain the new technologies for maintenance of infrastructure projects.

TEXTBOOKS:

1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.
5. New Building Materials and Construction World magazine

REFERENCE BOOKS:

1. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher: Belhaven Press.
2. Munier N, "Introduction to Sustainability", Springer 2005.
3. Sharma, “Sustainable Smart Cities In India: Challenges And Future Perspectives”, SPRINGER, 2022.
4. Ralph Horne, Tim Grant, Karli Verghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing,2009
5. European Commission - Joint Research Centre - Institute for Environment and

Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union;2010

AGM501	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	1	1	-	2	3	1	1	-	2	1	1	2	1	-
CO2	3	1	3	2	1	2	2	-	1	1	1	2	2	2	2	-
CO3	2	2	3	1	1	1	1	-	-	-	1	1	1	3	1	-
CO4	3	1	3	2	2	1	3	1	1	1	1	2	2	2	2	-
CO5	3	1	2	2	2	2	3	1	-	1	1	2	2	3	2	-
Average	3	1	3	2	2	2	3	1	1	1	1	2	2	3	2	-

AGM502	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To educate the students about the issues of sustainability in agroecosystems,
- To introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.
- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To introduce the students about the importance of the land and water resources in India.
- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.

UNIT- I AGROECOLOGY , AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS **9**

Ecosystem definition - Biotic *Vs*. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems.

UNIT- II SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT **9**

Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control.

UNIT- III WATER MANAGEMENT **9**

S oil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling –

Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use.

UNIT- IV ENERGY AND WASTE MANAGEMENT 9

Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture.

UNIT- V EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS 9

Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, students will be able

1. Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
2. Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
3. Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
4. Develop energy and waste management plans for promoting sustainable agriculture in non- sustainable farming areas
5. Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

TEXTBOOKS:

1. Approaches to Sustainable Agriculture — Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020

2. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
3. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.
4. Saroja Raman, “Agricultural Sustainability – Principles, Processes and Prospects”, CRC Press, 2013.
5. Prof Johannes S. C. Wiskerke, Dr Nevin Cohen, Dr Laine Young, Prof Alison Blay-Palmer, Achieving sustainable urban agriculture, 2020.

REFERENCE BOOKS:

1. Agricultural Economics and Agribusiness, Cramer, Jensen, and Southgate, John Wiley.
2. Agricultural Economics, Drummond and Goodwin, Prentice Hall.
3. T.C. Byerly, Environment and Agriculture, United States Dept. of Agriculture, Economic Research Service, 2006.
4. Natural bioactive products in sustainable agriculture, Singh, J. & Yadav, A.N., Springer, 2020
5. Organic Farming for Sustainable Agriculture, Nandwani, D., Springer, 2016.

AGM502	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	-	2	-	-	-	-	-	2	-	2	-	-	2	2	-	-
CO2	-	2	-	2	2	2	-	-	-	-	-	-	3	2	-	-
CO3	-	-	-	2		2	-	-	-	-	-	-	3	2	3	-
CO4	3	2	-	-	2	-	-	2	2	2	2	-	3	2	3	-
CO5	-	2	3	2	-	-	1	-	-	-	-	1	-	2	-	-
Average	3	2	3	2	2	2	1	2	2	2	2	1	3	2	3	-

AGM503	SUSTAINABLE BIO MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT- I INTRODUCTION TO BIOMATERIALS 9

Introduction: Definition of biomaterials, requirements & classification of biomaterials- Types of Biomaterials- Degradable and resorbable biomaterials- engineered natural materials- Biocompatibility-Hydrogels-pyrolitic carbon for long term medical implants-textured and porous materials-Bonding types- crystal structure-imperfection in crystalline structure-surface properties and adhesion of materials –strength of biological tissues-performance of implants-tissue response to implants- Impact and Future of Biomaterials

UNIT- II BIO POLYMERS 9

Molecular structure of polymers -Molecular weight - Types of polymerization techniques–Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials - Polyethylene -Polymethylmethacrylate (PMMA-Polylactic acid (PLA) and polyglycolic acid (PGA) - Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin-Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT- III BIO CERAMICS AND BIOCOMPOSITES 9

General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics-Biomedical Composites- Polymer Matrix Compsite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)– glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT- IV METALS AS BIOMATERIALS 9

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys- Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants — biological tolerance of implant metals

UNIT- V NANOBIOMATERIALS 9

Steel construction, Types of steel used for construction, Methods of utilizing steel construction, Advantages and Applications of steel in construction.

Advanced Materials: Adhesives in construction industry-Acrylics, Bridge bearings, Industrial waste materials in concrete Rapid wall panels, Moisture Barriers, Polymer foams and polymers in Building Physics. Polymer concrete composites.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will gain familiarity with Biomaterials and they will understand their importance.
2. Students will get an overview of different biopolymers and their properties
3. Students gain knowledge on some of the important Bioceramics and Biocomposite materials
4. Students gain knowledge on metals as biomaterials
5. Student gains knowledge on the importance of nanobiomaterials in biomedical applications.

TEXTBOOKS:

1. C. Mauli Agrawal, Joo L. Ong, Mark R. Appleford, Gopinath Mani “Introduction to Biomaterials Basic Theory with Engineering Applications” Cambridge University Press, 2014.
2. Donglu shi “Introduction to Biomaterials” Tsinghua University press, 2006.
3. Joon Park, R.S.Lakes “Biomaterials An Introduction” third edition, Springer 2007.
4. M.Jaffe,W.Hammond, P.Tolias and T.Arinzeh “Characterization of Biomaterials” Wood head publishing, 2013.

5. Buddy D.Ratner and Allan S.Hoffman Biomaterials Science “An Introduction to Material in Medicine” Third Edition, 2013.

REFERENCE BOOKS:

1. Vasif Hasirci, Nesrin Hasirci “Fundamentals of Biomaterials” Springer, 2018
2. Leopoido Javier Rios Gonzalez. “Handbook of Research on Bioenergy and Biomaterials: Consolidated and green process” Apple academic press, 2021.
3. Devarajan Thangadurai, Jeyabalan Sangeetha, Ram Prasad “Functional Bionanomaterials” springer, 2020.
4. Sujata.V.Bhat Biomaterials; Narosa Publishing house, 2002.
5. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

AGM503	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	2	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	1	2	1	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-
CO4	2	2	2	-	-	1	-	-	-	-	-	-	-	-	-	-
CO5	2	2	1	-	2	1	-	-	-	-	-	-	-	-	-	-
Average	2.2	1.8	1.8		1.7	1	-	-	-	-	-	-	-	-	-	-

AGM504	MATERIALS FOR ENERGY AND SUSTAINABILITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To familiarize the students about the challenges and demands of energy sustainability.
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell.
- To enable students to appreciate novel materials and their usage in photovoltaic application.
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT- I SUSTAINABLE ENERGY SOURCES 9

Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy.

UNIT- II ELECTROCHEMICAL DEVICES 9

Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O_2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, $LiCoO_2$, $LiFePO_4$, $LiMn_2O_4$) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based).

UNIT- III FUEL CELLS 9

Principle of operation of fuel cells – types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) — Thermodynamics of fuel cell — Fuel utilization — electrolyte membrane (proton conducting and anion conducting) — Catalysts (Platinum, Platinum alloys, carbon

supported platinum systems and metal oxide supported platinum catalysts) – Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

UNIT- IV PHOTOVOLTAICS 9

Physics of the solar cell – Theoretical limits of photovoltaic conversion – bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells – thin film silicon solar cells — multijunction solar cells — amorphous silicon based solar cells — photovoltaic concentrators — $Cu(InGa)Se_2$ solar cells – Cadium Telluride solar cells – dye sensitized solar cells – Perovskite solar cells – Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule-based solar cells materials - copper-phthalocyanine and perylenetetracarboxylicbis - benzine – fullerenes - boron subphthalocyanine- tin (II) phthalocyanine)

UNIT- V SUPERCAPACITORS 9

Supercapacitor –types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor- Faradaic and non - Faradaic capacitance — electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite- conductive polypyrrole hydrogels — Different types of nanocomposites for the SC electrodes (carbon–carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two - Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Students will acquire knowledge about energy sustainability and principles of different electrochemical devices and working of fuel cells and their application.
2. The students gain knowledge on different types of supercapacitors and the performance of various materials.
3. Comprehend and learn concepts related to building automation hardware and software and their application in smart buildings
4. Examine and apply lighting control, air conditioning and related applications in the context of smart buildings
5. Assess and apply other critical smart building applications and appreciate the role of data analytics in the control of building systems

TEXTBOOKS:

1. Functional materials for sustainable energy applications; John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards.
2. Hand Book of Fuel Cells: Fuel Cell Technology and Applications, Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, Wiley, London 2003.
3. B.E. Conway, Electrochemical supercapacitors: scientific fundamentals and technological applications, Kluwer Academic / Plenum publishers, New York, 1999.
4. T.R. Crompton, Batteries reference book, Newners, 3rd Edition, 2002.
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

REFERENCE BOOKS:

1. Electrode Materials for Supercapacitors: A Review of Recent Advances, Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai, catalysts 2020.
2. Recent advances, practical challenges, and perspectives of intermediate temperature solid oxide fuel cell cathodes Amanda Ndubuisi, Sara Abouali, Kalpana Singh and VenkataramanThangadurai, J. Mater. Chem. A, 2022.
3. Review of next generation photovoltaic solar cell technology and comparative materialistic development Neeraj Kant, Pushpendra Singh, Materials Today: Proceedings, 2022.

4. Raphael, B. (2022). Construction and Building Automation: From Concepts to Implementation. Routledge.
5. Sinopoli, J. M. (2009). Smart buildings systems for architects, owners and builders. Butterworth-Heinemann.

AGM504	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	-	3	-	-	-	-	-	2	-	-	-
CO2	1	-	-	-	-	-	-	-	1	-	-	2	-	3	1	-
CO3	-	-	-	3		1	2	-	-	-	-	-	-	2	-	2
CO4	-	-	-	-	-	-	-	1	-	-	3	-	1	-	2	-
CO5	-	-	-	-	-	1	1	3	2	-	-	2	-	-	-	-
Average	**1.5**	**-**	**-**	**3**	**-**	**1**	**2**	**2**	**1.5**	**-**	**3**	**2**	**1.5**	**2.5**	**1.5**	**2**

AGM505	GREEN TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To understand the principles of green chemistry and eco friendly methodologies.
- To create awarenes on Clener development mechanisms.
- To develop concepts on various energy efficient systems and green buildings.
- To provide green engineering solutions to energy demand, reduced energy

UNIT- I PRINCIPLES OF GREEN CHEMISTRY 9

Introduction to green chemistry and technology. Twelve principles of green chemistry, Green technology-definition, importance, factors affecting green technology. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.

UNIT- II POLLUTION TYPES 9

Pollution — types, causes, effects, and abatement. Waste — sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT- III GREEN REAGENTS AND GREEN SYNTHESIS 9

Cleaner development technologies Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labelling. Oxidation technology for waste water treatment- Cavitation, Fenton chemistry, photocatalysis and hybrid processes.

UNIT- IV DESIGNING GREEN PROCESSES 9

Energy efficient systems and processes Energy efficient motors, energy efficient lighting, control and selection of luminaries; bio-fuels, fuel cells- working, selection of fuels, Green manufacturing systems, selection of recyclable and environment friendly

materials in manufacturing, design and implementation of sustainable green production systems.

UNIT- V GREEN NANOTECHNOLOGY 9

Green Buildings Definition- Features and benefits, Fundamental planning decisions for energy efficient building- site selection, buildings forms and orientations, building fabrics and insulation, ventilation, passive solar features. Ecofriendly and cost-effective materials, Energy management, roof top solar photovoltaic system and solar tracking system, alternating roofing systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand the principles of green engineering and technology
2. To learn about pollution using hazardous chemicals and solvents
3. To modify processes and products to make them green and safe.
4. To design processes and products using green technology.
5. To understand advanced technology in green synthesis.

TEXTBOOKS:

1. Soli J. Arceivala, “GREEN TECHNOLOGIES”, McGraw Hill Education,2017.
2. Khan B.H, Non conventional energy resources, Tata McGraw-Hill, New Delhi 2006.
3. Green Chemistry – An introductory text - M. Lancaster, RSC, 2016.
4. Rashmi Sanghi and M.M. Srivastava, Green Chemistry-Environment Friendly Alternatives, Narosa Publishing House, New Delhi 2009.
5. Paul L. Bishop, Pollution prevention–Fundamentals and Practices, McGraw-Hill- international 2000.

REFERENCE BOOKS:

1. Ritu Dogra,”Renewable Energy and Green Technology”, Brillion Publishing, 2023.
2. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley

publications,2008

3. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017
4. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997
5. Sambit Kumar Mishra, Zdzislaw Polkowski, Samarjeet Borah, Ritesh Dash, “AI in Manufacturing and Green Technology: Methods and Applications” CRC Press, 2021.

AGM505	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	1	2	-	-	-	3	-	2	1	1	2	-
CO2	1	2	-	2	1	2	-	-	-	2	-	2	1	-	2	-
CO3	1	2	2	2	1	2	-	-	-	2	-	2	2	-	2	-
CO4	1	2	2	3	2	2	-	-	-	3	-	3	1	1	2	1
CO5	1	2	2	2	3	2	3	-	-	3	-	3	1	1	2	-
Average	1.0	2.0	2.0	2.0	2.0	2.0	3.0	0	0	3.0	0	2.0	1.0	1.0	2.0	1.0

AGM506	ENVIRONMENTAL QUALITY MONITORING AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.
- To know the analytical and instrumental methods to measure various IEQ parameters
- To familiarize the regulations, standards and guidelines of IEQ
- To learn the fundamentals of computational fluid dynamics (CFD)

UNIT- I ENVIRONMENTAL MONITORING AND STANDARDS 9

Introduction to indoor environmental quality – Parameters: Thermal Comfort - thermal balance of human body – instrumentation and measurement - impact of thermal comfort on human productivity and health.

UNIT- II MONITORING OF ENVIRONMENTAL PARAMETERS 9

Current Environmental Issues- Global Environmental monitoring programme-International conventions- Application of Environmental Monitoring- Atmospheric Monitoring - screening parameters – Significance of environmental sampling- sampling methods – water sampling - sampling of ambient air-sampling of flue gas.

UNIT- III ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING 9

Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods -Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction

to advanced instruments for environmental analysis

UNIT- IV ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISK ASSESSMENT **9**

Water quality monitoring programme- national water quality monitoring- Parameters for National Water Quality Monitoring- monitoring protocol; Process of risk assessment- hazard identification- exposure assessment- dose-response assessment; risk characterization.

UNIT- V AUTOMATED DATA ACQUISITION AND PROCESSING **9**

Fundamentals of mass transport – definition of intraphase and inter-phase chemical flux; interphase mass transport, diffusion coefficient and convenction mass transfer coefficients. Chemical Exchange between air-water Overall transport model and scenarios.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After completion of this course, the students will know

1. Basic concepts of environmental standards and monitoring.
2. The ambient air quality and water quality standards;
3. The various instrumental methods and their principles for environmental monitoring.
4. The significance of environmental standards in monitoring quality and sustainability of the environment.
5. The various ways of raising environmental awareness among the people.

TEXTBOOKS:

1. Environmental monitoring Handbook, Frank R. Burden, © 2002 by The McGraw-Hill Companies, Inc.
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and soild wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc.
3. Pengler, J.D.; McCarthy, J.F.; Same, J.M., Indoor Air Quality Handbook. McGraw Hill, 2000.
4. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.

5. Daoliang Li, Shuangyin Liu, “Water Quality Monitoring and Management” Elsevier, 2018.

REFERENCE BOOKS:

1. Nazaroff, W.W., and Alvarez-Cohen, L., Environmental Engineering Science. Wiley sons, Newyork, 2001.
2. H. H. Willard, L. L. Merit, J. A. Dean and F. A. Settle, Instrumental Methods of Analysis, CBP Publishers and Distributors, New Delhi, 1988.
3. Maroni, M.; Seifert, B.; Lindvall, T., Indoor Air Quality: A Comprehensive Reference Book. Elsevier Science Ltd, 1996.
4. Heaslip, G. (1975) Environmental Data Handling. John Wiley & Sons. New York.
5. Nicolas Mazzeo, “Air Quality Monitoring, Assessment and Management”, IntechOpen.

CE	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2	-	-	-	2	-	2	-	3	-	2	1	-	-	1
CO2	-	1	-	2	-	2	-	2	-	2	-	2	1	-	-	1
CO3	-	-	2	2	-	2	-	2	-	2	-	2	-	2	-	1
CO4	-	-	2	3	-	2	-	3	-	3	-	3	1	1	-	1
CO5	-	-	2	2	-	2	3	2	-	3	-	3	-	1	-	1
Average	1.0	2.0	2.0	2.0	0.0	2.0	3.0	2.0	0.0	3.0	0.0	2.0	1.0	1.0	0.0	1.0