

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

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

(Approved by AICTE, Affiliated to Anna University)



CURRICULA AND SYLLABI

**B.E - ELECTRONICS AND COMMUNICATION
ENGINEERING**

REGULATION 2023

SRM VALLIAMMAI ENGINEERING COLLEGE

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

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

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 instill creativity, responsibility, commitment and leadership qualities with professional ethics and moral values.

2. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

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

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

5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological Change.

4. PROGRAM SPECIFIC OUTCOMES (PSOs):

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

1. Ability to solve societal problems by applying knowledge acquired in the core domain.
2. Ability to apply technologies like VLSI, Embedded and Wireless Communications to meet the industrial requirements.

5. PEO / PO & PSO MAPPING

PEOs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	2	2	2	2	1	1	2	2	2	3	3	3
2	3	3	2	3	3	-	-	-		-	-	2	3	3
3	2	2	3	2	3	1	2	1	2	2	3	2	3	3
4	1	1	1	-	1	2	1	3	3	3	3	2	3	1
5	2	2	2	2	2	-	-	1	2	2	2	3	2	2

Contribution: 1 - Reasonable 2 - Significant 3 - Strong

MAPPING – UG - ELECTRONICS AND COMMUNICATION ENGINEERING

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
		Year I	Sem I														
	EN3111- Professional English - I	2	3	2	2	2	-	2	-	-	3	1	1	-	-		
	MA3122 - Matrices And Calculus	3	2	2	1	-	-	-	-	-	-	-	1	-	-		
	PH3123 - Engineering Physics	3	1	1	1	1	1	1	-	-	-	-	1	-	-		
	CH3124 - Engineering Chemistry	3	2	2	2	1	1	2	-	-	-	-	2	-	-		
	GE3132 - Basic Electrical and Instrumentation Engineering	2	1	1	-	-	-	-	1	-	-	-	-	-	-		
	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	3	1	1	-	-	-	-	-	-	-	-	-		
	GE3134 - Engineering Practices Laboratory	3	2	2	2	2	1	-	-	1	-	1	1	-	-		
Year I	Sem II	EN3211 - Professional English - II	2	2	1	2	2	-	2	-	-	3	1	1	-	-	
		MA3222 - Statistics and Numerical Methods	3	3	-	-	-	-	-	-	-	-	-	-	1	-	
		PH3223 - Physics for Electronics Engineering	3	2	2	1	2	2	3	-	-	-	-	1	-	-	
		CH3223 - Chemistry of Electronic Materials	3	2	2	2	2	1	1	-	-	-	-	2	2	-	
		GE3231 - Problem Solving and Python Programming	2	3	3	3	2	-	-	-	-	-	2	2	-	-	
		GE3211 - தமிழரும் தொழில்நுட்பமும் / Tamils and Technology															
		GE3221 - Engineering Sciences Laboratory	2	1	1	1	1	1	1	1	-	-	-	-	-	-	
		GE3232 - Problem Solving and Python Programming Laboratory	2	3	3	3	2	-	-	-	-	-	2	2	-	-	
		GE3233 - Engineering Graphics And Design	2	-	3	-	1	-	-	-	-	1	3	-	2	-	-
		GE3251 - NSS / YRC / NSO / Club Activities#															

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
			Year II	Sem III	MA3321 - Transforms and Partial Differential Equations	3	3	-	-	1	-	-	-	-	-	-	1
		EC3362 - Solid State Devices and Circuits	3	3	3	3	-	-	-	-	-	-	-	2	2	2	
		EC3363 - Signals and Systems	3	3	3	3	-	-	-	-	-	-	-	3	2	3	
		EE3363 - Electric Circuit Analysis	1	1	1	2	2			3			3	2	-	-	
		EC3365 - Electromagnetic Fields	3	2	1	2	-	-	-	-	-	-	-	2	2	1	
		EC3366 - Digital Systems Design	2	3	3	2	2	-	-	-	3	-	-	2	2	2	
		EC3367 - Electronics Circuits Design Laboratory	3	3	2	3	2	2	2	2	3	3	2	2	3	2	
		EE3369 - Circuit Theory and Electronic Devices Laboratory	3	3	2	2	3	-	-	1	2	-	2	2	-	-	
Year II	Sem IV	MA3424 - Applied Mathematics for Electronics and Communication Engineering	3	3	3	2	1	-	-	-	-	-	1	1	-	-	
		EC3462 - Linear Integrated Circuits	3	2	3	2	2	-	-	-	-	-	-	1	3	3	
		EC3463 - Analog Communication	2	2	2	2	-	1	-	-	-	-	-	2	3	1	2
		EC3464 - Microprocessors, Microcontrollers And Interfacing	2	1	2	2	3	1	-	-	-	-	-	3	2	2	1
		EI3464 - Control Systems	3	3	1	2	-	-	-	-	3	-	3	-	1	-	-
		GE3451 - NCC Credit Course Level - I															
		EC3465 - Digital Signal Processing	3	3	3	3	-	-	-	-	-	2	-	-	-	2	3
		EC3466 - Linear IC and PCB Design Laboratory	3	2	2	2	2	2	1	-	-	2	3	3	2	3	2
		EC3467- Microprocessors, Microcontrollers and Interfacing Laboratory	2	2	3	2	3	2	2	2	2	2	2	-	2	2	2

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
			Year III	Sem V	EC3561-Digital Communication	3	3	3	3	-	-	-	-	-	-	-	2	3
		EC3562 - Transmission Lines and Waveguides	2	3	2	2	-	-	-	-	-	-	-	2	2	2		
		EC3563 - VLSI and Chip Design	2	2	3	2	3	-	-	-	2	-	-	2	2	2		
		PEC10X-Professional Elective-I																
		PEC20X-Professional Elective-II																
		CE3531 - Environmental Studies	3	2	1	1	-	2	2	-	-	-	-	2	-	-		
		GE3551 - NCC Credit Course Level-II													-	-		
		EC3564- Embedded Systems and IoT Design	3	3	3	3	3	1	-	-	3	-	-	2	2	2		
		EC3566-VLSI Design Laboratory	2	2	2	2	3	2	2	2	3	2	2	1	2	2		
		EC3567-Analog and Digital Communication Laboratory	3	3	3	3	2	1	2	-	3	2	1	1	3	2		
Year III	Sem VI	EC3661-Wireless Communication	3	3	3	2	-	-	-	-	-	-	-	2	2	2		
		EC3662-Computer Networks and Security	2	2	3	2	-	-	-	-	-	-	-	-	2	2	2	
		EC3663-Antennas and Wave Propagation	3	3	2	3	-	-	-	-	-	-	-	-	2	3	2	
		PEC30X-Professional Elective-III																
		PMD40X-Professional Elective-IV																
		MAN10X-Management Elective-I																
		MXX10X-Mandatory Course-I																
		EC3664-Wireless Communication and Networking Laboratory	2	2	3	2	3	2	2	-	2	2	2	2	2	2	2	3
		EC3645-Mini Project	3	3	3	3	3	2	2	2	2	2	2	2	2	2	3	2
		EN3649-Professional Communication Laboratory	1	1	1	1	1	1	-	1	-	-	3	-	1	-	-	

		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2		
Year IV	Sem VII	EC3761-Microwave and Optical Communication	3	3	2	3	-	-	-	-	-	-	-	2	3	2	
		PEC50X-Professional Elective-V															
		PMD60X-Professional Elective-VI															
		BA3711-Human Values and Ethics	-	-	1	2	-	-	1	-	-	-	-	-	-	-	-
		OXXXXX-Open Elective *															
		MX20X-Mandatory Course-II															
		EC3763-Artificial Intelligence and Machine Learning Techniques	3	3	2	2	-	-	-	-	-	-	-	-	3	2	3
		EC3764-Microwave and Optical Communication Laboratory	3	2	2	1	-	-	-	3	2	-	2	2	2	2	3
		EC3745-Summer Internship															
Year IV	Sem VIII	EC3841-Project Work	3	3	3	3	3	2	2	2	2	3	3	3	3	3	

Contribution: 1 - Reasonable 2 - Significant 3 - Strong

SRM VALLIAMMAI ENGINEERING COLLEGE

(AN AUTONOMOUS INSTITUTION)

SRM Nagar, Kattankulathur - 603 203.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CHOICE BASED CREDIT SYSTEM

R2023

CURRICULUM FOR SEMESTERS 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	GE3132	Basic Electrical and Instrumentation 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 Laboratory	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	PH3223	Physics for Electronics Engineering	BSC	3	0	0	3	3
4	CH3223	Chemistry of Electronic Materials	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	EC3362	Solid State Devices and Circuits	PCC	3	0	0	3	3
3	EC3363	Signals and Systems	PCC	3	0	0	3	3
4	EE3363	Electric Circuit Analysis	PCC	3	0	0	3	3
5	EC3365	Electromagnetic Fields	PCC	3	0	0	3	3
THEORY CUM PRACTICAL								
6	EC3366	Digital Systems Design	PCC	3	0	2	5	4
PRACTICAL								
7	EC3367	Electronics Circuits Design Laboratory	PCC	0	0	3	3	1.5
8	EE3369	Circuits Theory and Electronic Devices Laboratory	PCC	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	MA3424	Applied Mathematics for Electronics and Communication Engineering	BSC	2	0	0	2	2
2	EC3462	Linear Integrated Circuits	PCC	3	0	0	3	3
3	EC3463	Analog Communication	PCC	3	0	0	3	3
4	EC3464	Microprocessors, Microcontrollers and Interfacing	PCC	3	0	0	3	3
5	EI3464	Control Systems	PCC	3	0	0	3	3
6	GE3451	NCC Credit Course Level - I*	PCD	3	0	0	3	3
THEORY CUM PRACTICAL								
7	EC3465	Digital Signal Processing	PCC	3	0	2	5	4
PRACTICAL								
8	EC3466	Linear IC and PCB Design 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 1 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	EC3561	Digital Communication	PCC	3	0	0	3	3
2	EC3562	Transmission Lines and Waveguides	PCC	3	0	0	3	3
3	EC3563	VLSI and Chip Design	PCC	3	0	0	3	3
4	PEC10X	Professional Elective-I	PEC	3	0	0	3	3
5	PEC20X	Professional Elective-II	PEC	3	0	0	3	3
6	CE3531	Environmental Studies	ESC	2	0	0	2	2
7	GE3551	NCC Credit Course Level-II #	PCD	3	0	0	3	3
THEORY CUM PRACTICAL								
9	EC3564	Embedded Systems and IoT Design	PCC	3	0	2	5	4
PRACTICAL								
10	EC3566	VLSI Laboratory	PCC	0	0	3	3	1.5
11	EC3567	Analog and Digital Communication Laboratory	PCC	0	0	3	3	1.5
Total				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	EC3661	Wireless Communication	PCC	3	0	0	3	3
2	EC3662	Computer Networks and Security	PCC	3	0	0	3	3
3	EC3663	Antennas and Wave Propagation	PCC	3	0	0	3	3
4	PEC30X	Professional Elective-III	PEC	3	0	0	3	3
5	PXXX0X	Professional Elective-IV	PEC	3	0	0	3	3
6	MAN10X	Management Elective	HSMC	2	0	0	2	2
7	MXX10X	Mandatory Course-I	MC	3	0	0	3	0
PRACTICAL								
8	EC3664	Wireless Communication and Networking Laboratory	PCC	0	0	3	3	1.5
9	EC3645	Mini Project	EEC	0	0	4	4	2
10	EN3649	Professional Communication Laboratory	EEC	0	0	2	2	1
Total				20	0	9	29	21.5

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

Management Elective shall be chosen from the Management Elective Courses

Semester-VII								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	EC3761	Microwave and Optical Communication	PCC	3	0	0	3	3
2	PEC50X	Professional Elective-V	PEC	3	0	0	3	3
3	PEC60X	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	MXX20X	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	EC3764	Microwave and Optical Communication Laboratory	PCC	0	0	3	3	1.5
9	EC3745	Internship	EEC	0	0	0	0	1
Total				20	0	5	25	20.5

* Open Elective shall be chosen from the emerging technologies.

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

Semester-VIII								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
PRACTICAL								
1	EC3841	Project Work	EEC	0	0	20	20	10
Total				0	0	20	20	10

TCP-Total Contact Periods

Total Credits: 165

MANAGEMENT ELECTIVE COURSES								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
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	
THEORY								
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	
THEORY								
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

PE	Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI
	Semiconductor Chip Design and Testing	Signal Processing	RF Technologies	Bio Medical Technologies	Sensor Technologies and IoT	High Speed Communications
1	Wide Bandgap Devices	Advanced Digital Signal Processing	RF System Design	Medical Electronics	Internet of Things	Satellite and Radar Communication
2	Validation and Testing Technology	DSP Architecture and Programming	RFID System Design and Testing	Human Assist Devices	MEMS Design	Wireless Broad Band Networks
3	Analog IC Design	Speech processing	Signal Integrity	Therapeutic Equipment	IoT Processors	Advanced Wireless Communication Techniques
4	Low Power Design	Digital Image processing	RF Transceivers	Medical Imaging Techniques	Wireless Sensor Network Design	Software Defined Networks
5	Mixed Signal IC Design Testing	Software Defined Radio	EMI/EMC Pre compliance Testing	Wearable Devices	Industrial IoT	5G and Beyond
6	VLSI Testing and Design For Testability	Computer Vision	Antenna Design	Brain Computer Interface and Applications	Nanoelectronics	Massive MIMO Networks

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. 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. Total number of courses per vertical may change in the each programme of study as 6 or 7 or 8. If there is shortage of courses in a vertical the same may be chosen from another vertical of the same programme.

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL-I: SEMICONDUCTOR CHIP DESIGN AND TESTING								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEC101	Wide Bandgap Devices	PEC	3	0	0	3	3
2	PEC102	Validation and Testing Technology	PEC	3	0	0	3	3
3	PEC103	Analog IC Design	PEC	3	0	0	3	3
4	PEC104	Low Power Design	PEC	3	0	0	3	3
5	PEC105	Mixed Signal IC Design Testing	PEC	3	0	0	3	3
6	PEC106	VLSI Testing and Design For Testability	PEC	3	0	0	3	3

VERTICAL-II: SIGNAL PROCESSING								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEC201	Advanced Digital Signal Processing	PEC	3	0	0	3	3
2	PEC202	DSP Architecture and Programming	PEC	3	0	0	3	3
3	PEC203	Speech Processing	PEC	3	0	0	3	3
4	PEC204	Digital Image Processing	PEC	3	0	0	3	3
5	PEC205	Software Defined Radio	PEC	3	0	0	3	3
6	PCS505	Computer Vision	PEC	3	0	0	3	3

VERTICAL-III: RF TECHNOLOGIES								
S.No	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEC301	RF System Design	PEC	3	0	0	3	3
2	PEC302	RFID System Design and Testing	PEC	3	0	0	3	3
3	PEC303	Signal Integrity	PEC	3	0	0	3	3
4	PEC304	RF Transceivers	PEC	3	0	0	3	3
5	PEC305	EMI/EMC Pre compliance Testing	PEC	3	0	0	3	3
6	PEC306	Antenna Design	PEC	3	0	0	3	3

VERTICAL-IV: BIO-MEDICAL TECHNOLOGIES								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEC401	Medical Electronics	PEC	3	0	0	3	3
2	PMD602	Human Assist Devices	PEC	3	0	0	3	3
3	PEC402	Medical Equipment	PEC	3	0	0	3	3
4	PEC403	Medical Imaging Systems	PEC	3	0	0	3	3
5	PMD502	Wearable Devices	PEC	3	0	0	3	3
6	PMD404	Brain Computer Interface and Its Applications	PEC	3	0	0	3	3

VERTICAL-V: SENSOR TECHNOLOGIES AND IOT								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEC501	Internet of Things	PEC	3	0	0	3	3
2	PEC502	MEMS Design	PEC	3	0	0	3	3
3	PEC503	IoT Processors	PEC	3	0	0	3	3
4	PEC504	Wireless Sensor Network Design	PEC	3	0	0	3	3
5	PEC505	Industrial IoT	PEC	3	0	0	3	3
6	PEC506	Nano Electronics	PEC	3	0	0	3	3

VERTICAL-VI: HIGH SPEED COMMUNICATIONS								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEC601	Satellite and Radar Communication	PEC	3	0	0	3	3
2	PEC602	Wireless Broadband Networks	PEC	3	0	0	3	3
3	PEC603	Advanced Wireless Communication Techniques	PEC	3	0	0	3	3
4	PEC604	Software Defined Networks	PEC	3	0	0	3	3
5	PEC605	5G and Beyond	PEC	3	0	0	3	3
6	PEC606	Massive MIMO Networks	PEC	3	0	0	3	3

OPEN ELECTIVE COURSES

S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
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	OCS101	IoT and its Applications	CSE	3	0	0	3	3
8	OCS102	Machine Learning with R	CSE	3	0	0	3	3
9	OCS103	Tamil Computing	CSE	3	0	0	3	3
10	OCY101	Cyber Forensic and Investigation	CYS	3	0	0	3	3
11	OCY102	Social Media Security	CYS	3	0	0	3	3
12	OEE101	Renewable Energy sources	EEE	3	0	0	3	3
13	OEE102	Energy Conservation and Management	EEE	3	0	0	3	3
14	OEE103	Electric and Hybrid Vehicles	EEE	3	0	0	3	3
15	OEI101	Fundamentals of Robotics	EIE	3	0	0	3	3
16	OEI102	Sensors for Engineering Applications	EIE	3	0	0	3	3
17	OMD101	Introduction to Food Processing	MDE	3	0	0	3	3
18	OMD102	Introduction to Biomedical Instrumentation	MDE	3	0	0	3	3
19	OIT101	Multimedia Technologies	IT	3	0	0	3	3
20	OIT102	3D Printing and its Applications	IT	3	0	0	3	3
21	OIT103	Web Frameworks	IT	3	0	0	3	3
23	OAD101	Foundation of Data Science	AI&DS	3	0	0	3	3
24	OAD102	Open source software tools	AI&DS	3	0	0	3	3
25	OME101	Refrigeration and Air conditioning	MECH	3	0	0	3	3
25	OME102	Advanced Manufacturing Processes	MECH	3	0	0	3	3
26	OME103	Material Testing and Characterization	MECH	3	0	0	3	3
27	OME104	Hazardous Waste Management	MECH	3	0	0	3	3
28	OME105	Automotive Engineering	MECH	3	0	0	3	3
29	OCH132	Nanomaterials and Applications	Chem.	3	0	0	3	3
30	OPH131	Advanced Functional materials	Physics	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	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	5	4					2		11
2	BSC	14	10	3	2	2	2			33
3	ESC	3	10							13
4	PCC			19	19	16	10.5	8.5		73
5	PEC					6	6	6		18
6	OEC							3		3
7	EEC						3	1	10	14
8	PCD		1#							0
9	Mandatory Course (Non-credit)						0	0		0
Total		22	24	22	21	24	21.5	20.5	10	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 Blockchain	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 for Business	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

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

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	3	2	2	2	-	2	-	-	3	1	1	-	-	-	-

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:

- To apply the idea of reducing complex problems into simple form using matrix technique.
- Basic application of calculus in engineering problems and to tackle for different geometries.
- This course equips the students to have basic knowledge and understanding the
- Partial derivatives and maxima and minima by Lagrange's method.
- Basic application of Double and Triple integrals used in Engineering real life problems
- 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", Eighth 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.

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

No Correlation -

Low 1

Medium 2

High 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	3	1	1	1	1	1	1	-	-	-	-	1	-	-	-	-

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

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:

1. To infer the quality of water from quality parameter data and propose suitable treatment.
2. To apply the knowledge of chemical thermodynamics for material design and aspects
3. To recommend the proper chemical kinetics for engineering processes and applications.
4. To recognize the surface morphology and its engineering applications.
5. 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.

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

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

COURSE OBJECTIVES:

To impart knowledge on Operation of Three phase electrical circuits and power measurement

Working principles of Electrical Machines

Working principle of various measuring instruments

UNIT I AC CIRCUITS AND POWER SYSTEMS 9

Three phase power supply – Star connection – Delta connection – Balanced and Unbalanced Loads- Power equation – Star Delta Conversion – Three Phase Power Measurement - Transmission & Distribution of electrical energy – Over head Vs Underground system – Protection of power system – types of tariff – power factor improvement

UNIT II TRANSFORMER 9

Introduction - Ideal Transformer – Accounting For Finite Permeability And Core Loss – Circuit Model Of Transformer – Per Unit System – Determination Of Parameters of Circuit Model Of Transformer – Voltage Regulation – Name Plate Rating – Efficiency – Three Phase Transformers - Auto Transformers

UNIT III DC MACHINES 9

Introduction – Constructional Features– Motoring and generation principle - Emf And Torque equation – Circuit Model – Methods of Excitation and magnetisation characteristics – Starting and Speed Control – Universal Motor

UNIT IV AC MACHINES 9

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit, Single phase Induction motors -Construction– Types–starting and speed control methods. Alternator- working principle–Equation of induced EMF – Voltage regulation, Synchronous motorsworking principle-starting methods – Torqueequation – Stepper Motors – Brushless DC Motors

UNIT V MEASUREMENT AND INSTRUMENTATION 9

Type of Electrical and electronic instruments – Classification- Types of indicating Instruments – Principles of Electrical Instruments –Multimeters, Oscilloscopes- Static and Dynamic Characteristics of Measurement – Errors in Measurement – Transducers - Classification of Transducers: Resistive, Inductive, Capacitive, Thermoelectric, piezoelectric, photoelectric, Hall effect and Mechanical

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

Understand the concept of three phase power circuits and measurement.

Comprehend the concepts in electrical generators, motors and transformers

Choose appropriate measuring instruments for given application

TEXT BOOKS:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint, 2016.
2. Giorgio Rizzoni, "Principles and Applications of Electrical Engineering", McGrawHill Education(India) Private Limited, 2010
3. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson, India,2011

REFERENCE BOOKS:

1. Del Toro ,"Electrical Engineering Fundamentals", Pearson Education, New Delhi,2015.
2. Leonard S Bobrow, " Foundations of Electrical Engineering", Oxford UniversityPress, 2013
3. Rajendra Prasad ,"Fundamentals of Electrical engineering", Prentice Hall of India,2006.
4. Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, 24th reprint 2016
5. A.E.Fitzgerald, David E Higginbotham and Arvin Gabel, "Basic Electrical Engineering", McGraw Hill Education(India) Private Limited, 2009

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

அலகு I மொழி மற்றும் இலக்கியம் 3
இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள்- தமிழ் ஒரு செம்மொழி- தமிழ் செவ்விலக்கியங்கள்- சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம்- திருக்குறளில் மேலாண்மைக் கருத்துகள்- தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமணப் பெளத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள்- சிற்றிலக்கியங்கள்- தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் – சிற்பக் கலை 3
நடுகல் முதல் நவீன சிற்பங்கள் வரை –ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள் , பொம்மைகள்- தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள்

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3
நாட்டுப்புற கதைகள், பாடல்கள்-தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து- ஓயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம்- வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் 3
தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள்- தமிழர்கள் போற்றிய அறக்கோட்பாடு –தமிழ் சங்கம்-சங்கம் வளர்த்த தமிழ்-சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும்- சங்ககால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு 3
இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு இந்தியா மற்றும் வெளிநாட்டின் பிற பகுதிகளின் தமிழ்ப் பண்பாட்டின் தாக்கம்- சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு- கல்வெட்டுகள், கையெழுத்துப்படிசைகள் – தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு

Total Periods: 15 hours

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முனைவர். இல.சுந்தரம். (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
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) (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.

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as 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 modern sculpture - 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, Leather puppetry, 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 வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் – முனைவர். இல.சுந்தரம். (விகடன் பிரசுரம்)
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
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) (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.

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	2	1	1	1	2	-	2	-	-	3	-	1	-	-	-	-

(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

1. Understand the functioning of various physics laboratory equipment.
2. Use graphical models to analyze laboratory data.
3. Use mathematical models as a medium for quantitative reasoning and describing physical reality.
4. Access, process and analyze scientific information.
5. Solve problems individually and collaboratively.

REFERENCES

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

Course Outcomes	PROGRAM OUTCOMES												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

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.

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 ($\text{Ag}/\text{Au}/\text{TiO}_2/\text{ZnO}/\text{CuO}$).
11. Pseudo first-order kinetics- ester hydrolysis.

TOTAL: 30 PERIODS**OUTCOMES****At the end of the course, the student should be able:**

1. To infer the quality of water samples for alkalinity, hardness, DO, TDS, chloride, and chlorine.
2. To apply the knowledge on the estimation of metal ions, acidity and its precipitation nature towards their process.
3. To recognize the threshold limit for various characteristics of domestic water.
4. To identify the simple method of synthesis of nanoparticles.
5. 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	2	1	1	1	1	-	1	-	-	-	-	-	-	-	-	-	-
CO2	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	2	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	1	1	1	2	-	-	-	-	-	-	1	-	-	-	-	-
CO5	2	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
AVG	2	1	1	1	1	-	1	-	-	-	-	1	-	-	-	-	-

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

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.

GROUPA(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	1	1	1	1	2	3	4
1	3					1						1	-	-	-	-
2		1	2		3							1	-	-	-	-
3				3	2							1	-	-	-	-
4		2	3	1	2								-	-	-	-
5		3	2	2					1				-	-	-	-
Avg	3	2	2	2	2	1	-	-	1	-	1	1	-	-	-	-

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

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.

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	2	2	-	2	-	-	3	1	1	-	-	-	-

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 derivatives 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:

- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- 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.

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

OBJECTIVES:

- To understand the concept of free electron theories and to get knowledge on conducting and superconducting materials
- To impart the knowledge about basics of doping and types of semiconductors.
- To enable the idea of magnetism and dielectric properties.
- To explore the basics of interaction of photon with materials
- To enhance the fundamental knowledge of molecular electronics and nano devices.

UNIT- I: CONDUCTING AND SUPERCONDUCTING MATERIALS**9**

Classical free electron theory-Postulates - Expression for electrical conductivity and Thermal conductivity - Wiedemann-Franz law - Success and failures - Quantum free electron theory (qualitative) - Fermi Distribution function - Density of energy states - carrier concentration – Superconductors – Properties - Applications : Magnetic levitation, Cryotron and SQUID.

UNIT- II: SEMICONDUCTOR AND TRANSPORT PHYSICS**9**

Properties - Direct and indirect semiconductors - Intrinsic Semiconductors - Carrier concentration in intrinsic semiconductors - Extrinsic semiconductors - Carrier concentration in N - type & P- type semiconductors - Fermi energy - Variation of fermi level with temperature - Carrier transport - Drift and Diffusion transport - Hall Effect - Theory and Experiment - PN junction diode - Forward and reverse bias characteristics.

UNIT- III: MEMORY STORAGE MATERIALS AND DIELECTRIC MATERIALS**9**

Magnetism in materials - Diamagnetic material, Paramagnetic material and Ferromagnetic material - Ferromagnetic domain theory - Hysteresis Curve - Hard and soft magnetic material - Bubble memory - Dielectric material : Electronic polarization, ionic polarization, orientational polarization and space - charge polarization - dielectric loss - dielectric breakdown - high - k dielectrics.

UNIT – IV: OPTOELECTRONIC DEVICES

9

Classification of optical materials Optical processes in semiconductors: optical absorption and emission - carrier injection and recombination - photo diode - solar cell - photo detectors - Light Emitting Diode - Organic LED - Optical switching – Plasmonics

UNIT – V : MOLECULAR ELECTRONICS

9

Introduction to Nanotechnology - Size dependence of Fermi energy - quantum confinement – Excitons – HOMO - LUMO - Organic semiconductor (qualitative) - quantum structures - Quantum wire, Quantum Well, Quantum Dot laser - quantum interference effects – Tunneling : Resonant Tunnelling Diode (RTD) - Resonant Tunnelling Transistor (RTT) - Coulomb blockade effects - Single electron phenomena and Single electron Transistor - Nano Robotics.

TOTAL:45 PERIODS

OUTCOMES:

After the completion of the course, the students should be able

1. To gain knowledge in energy band structures and superconducting materials.
2. To acquire knowledge on basics of semiconductor physics and its applications in various devices.
3. To gain knowledge about the properties and applications of magnetic and dielectric materials.
4. To have the necessary understanding on the functioning of optical materials for optoelectronic devices.
5. To understand the basics of quantum structures and their applications in nano electronics.

TEXT BOOKS:

1. Kasap, S.O., “Principles of Electronic Materials and Devices”, McGraw- Hill Education, 2007.
2. M. Arumugam, “Semiconductor Physics and optoelectronics”, Anuradha agencies,2003.
3. Wahab, M.A. “Solid State Physics: Structure and Properties of Materials”. Narosa Publishing House, 2009.
4. Kittel, C., “Introduction to Solid State Physics”, Wiley, 2005.
5. B.K.Pandey., S.Chaturvedi., “Engineering Physics”, Cengage Learning, 2012.
6. V.Rajendiran, Engineering Physics, Tata McGraw-Hill, New Delhi. 2011.

REFERENCE BOOKS:

1. B. N. Sankar., S. O. Pillai., “Engineering Physics” New age international publishers, 2007.
2. Donald .A.Neamen., “Semiconductor Physics and devices” Tata Mc Graw-Hill, New Delhi. 2007
3. Rogers, B., Adams, J. & Pennathur, S. “Nanotechnology: Understanding Small Systems”, CRC Press, 2014.

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	-	-	-	-
2	3	2	2	-	2	-	-	-	-	-	-	1	-	-	-	-
3	3	2	1	1	-	2	-	-	-	-	-	1	-	-	-	-
4	3	-	1	-	3	2	3	-	-	-	-	1	-	-	-	-
5	3	-	2	1	2	1	-	-	-	-	-	1	-	-	-	-
Avg	3	1.66	1.5	1	2	1.5	3					1	-	-	-	-

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

OBJECTIVES

- To make the students accustomed to carbon-based materials, their synthetic properties, and their application in the field of electrical and electronics.
- To comprehend the synthetic properties and applications of polymers in engineering applications.
- To acquaint the student with the principles of electrochemical reactions, and corrosion.
- To understand the working principle and applications of analytical instruments in chemical analysis.
- To make the student conversant with the basics of energy sources and storage devices, their properties, and applications.

UNIT I CHEMISTRY OF CARBON 9

Catenation property of carbon-carbon based compounds - structure and bonding - hydrocarbons: fuels, carbon-based organic materials, activated carbon, and allotrope of carbon: properties - applications of diamond, graphite, graphene, fullerenes, and carbon nanotubes - types – preparation – properties - applications (electrical and electronic field) - future perspective in energy conversion and storage.

UNIT II ENGINEERING POLYMERS 9

Polymers: Classification - types of polymerization - plastic and its types – applications - Engineering polymers: ABS, PVC, Nylon-6, Nylon-6,6, Teflon, Kevlar and PEEK - preparation, properties and uses - fiber reinforced polymers - conducting polymers: types, and applications - applications of polymers in medicine and surgery.

UNIT III ELECTROCHEMISTRY AND CORROSION 9

Electrode - electrode reaction - redox reaction - origin of electrode potential, oxidation potential - reduction potential - measurement and applications, electrochemical series and its significance - electrochemical cell - Nernst equation (derivation). Corrosion - causes - factors - types - chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electroplating of Au - electroless plating of Ni - paints - constituents and function.

UNIT IV ENERGY SOURCES AND STORAGE DEVICES 9

Introduction - nuclear energy - light water nuclear power plant - breeder reactor, solar energy conversion - solar cells: principle, working and applications, types of batteries - primary battery (alkaline battery), secondary battery (lead acid battery, NICAD battery, lithium-ion battery), fuel cells (H₂-O₂ fuel cell). Supercapacitors: storage principle, applications. Electric vehicles-working principles.

Introduction, absorption of radiation, types of spectra, UV-Visible and IR Spectrophotometer: Instrumentation and applications, cyclic voltammetry for redox system. Thermal methods of analysis TGA, DTA, DSC. Sensors: oxygen, pulse oximeter, biometrics, and glucose sensor.

Total Periods: 45

OUTCOMES

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

1. To explain the carbon-based materials' properties and their engineering applications.
2. To gain knowledge on various types of engineering polymers.
3. To understand the process of electrochemistry and its application in corrosion control.
4. To appraise the working principles and applications of analytical instruments.
5. To ability to understand energy sources and storage devices.

TEXTBOOKS

1. Shikha Agarwal, "Engineering Chemistry"-Fundamentals and Applications, 2nd Edition, Cambridge University Press, New Delhi, 2019.
2. P. C. Jain and Monica Jain, "Engineering Chemistry", 18th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2021.
3. S. Vairam, P. Kalyani and Suba Ramesh, "Engineering Chemistry", Wiley India PVT, LTD, New Delhi, 2013.

REFERENCES

1. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
2. S.S. Dara and S.S. Umare, "A Text Book of Engineering Chemistry", 12th Edition, S. Chand & Company LTD, New Delhi, 2018.
3. B. Sivasankar, "Engineering Chemistry", Tata McGraw-Hill Publishing Company LTD, 2023.
4. R. V. Gadag and A. Nithyananda Shetty, "Engineering Chemistry", 3rd Edition, Wiley & I.K. International (P), LTD, New Delhi, 2019.

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

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

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:

- Develop simple computational problems using control flow statements.
- Decompose a Python program into functions, Modules and Packages.
- Represent compound data using Python lists, tuples, Strings, Set and dictionaries.
- Read and write data from/to files and Exception handling in Python Programs.
- 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 Montoyo, **“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	3	3	3	3	2	-	-	-	-	-	2	2	-	-	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	-	-	-	-
4	2	2	-	2	2	-	-	-	-	-	1	-	-	-	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	-	-	-	-
6	2	2	-	-	2	-	-	-	-	-	1	-	-	-	-	-
AVg.	2	3	3	3	2	-	-	-	-	-	2	2	-	-	-	-

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம் : 3

சங்க காலத்தில் நெசவுத் தொழில் - பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு. சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ - சாரோசெனிக் கட்டிடக் கலை.

அலகு III உற்பத்தித் தொழில்நுட்பம் : 3

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை - இரும்பை உருக்குதல், எஃகு - வரலாற்றுச் சான்றுகளாகச் செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல் - மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள், கண்ணாடி மணிகள் - சுடுமண் மணிகள் - சங்கு மணிகள் - எலும்புத்துண்டுகள் - தொல்லியல் சான்றுகள் - சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் : 3

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குழுவித் தூம்பின் முக்கியத்துவம் - கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் - கடல்சார் அறிவு - மீன்வளம் - முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ் : 3

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின் நூலகம் - இணையத்தில் தமிழ் அகராதிகள் - சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

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 household 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 Thoempu 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 வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி / வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருதை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
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.

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

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: PHYSICS LABORATORY (Any 5 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

1. To understand the functioning of various physics laboratory equipment.
2. To use graphical models to analyze the laboratory data and to solve problems individually and collaboratively.
3. Use mathematical models as a medium for quantitative reasoning and describing physical reality.
4. Access, process and analyze scientific information.
5. Solve problems individually and collaboratively.

TEXTBOOKS:

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

Course Outcomes	PROGRAM OUTCOMES												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	3	1	1	-	-	-	-	-	-	-	-	-	-	-	-

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

CHEMISTRY LABORATORY: (Any five experiments to be conducted)**L T P C****0 0 2 1****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.

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:

1. To find the quality of water samples for copper and chromium present in water.
2. To recognize the amount of various ions present in the water sample through volumetric and instrumentation techniques.
3. To identify the molecular weight of the polymer using an Ostwald viscometer.
4. To recognize an environmental hazardous and threshold limit for industrial effluents.
5. 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).

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	-	-	-	-	-	-	-	-	-	-	-
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	-	-	-	-	-	-	-	-

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

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.
- 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

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

CO'	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	-	-	-	-
2	3	3	3	3	3	-	-	-	-	-	3	2	-	-	-	-
3	3	3	3	3	2	-	-	-	-	-	2	-	-	-	-	-
4	3	2	-	2	2	-	-	-	-	-	1	-	-	-	-	-
5	1	2	-	-	1	-	-	-	-	-	1	-	-	-	-	-
6	2	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-
AVg.	2	3	3	3	2	-	-	-	-	-	2	2	-	-	-	-

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 and special curves.
2. To draw the orthographic projection of lines and plane surfaces.
3. To draw the projections and solids and Isometric projection of simple solids.
4. To draw 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:

1. To construct the conics curves and special curves.
2. To construct the orthographic projection of lines and plane surfaces.
3. To construct the projections and solids and Isometric projection of simple solids.
4. To construct projections of section of solids and development of surfaces.
5. 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	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	3	-	1	-	-	-	1	3	-	2	-	-	-	-
2	2	-	3	-	1	-	-	-	1	3	-	2	-	-	-	-
3	2	-	3	-	1	-	-	-	1	3	-	2	-	-	-	-
4	2	-	3	-	1	-	-	-	1	3	-	2	-	-	-	-
5	2	-	3	-	1	-	-	-	1	3	-	2	-	-	-	-
AVG	2	-	3	-	1	-	-	-	1	3	-	2	-	-	-	-

GE3251	NSS / YRC / NSO / Club Activities#	L	T	P	C
		0	0	1	1#

GE3251-

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 their 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

GE3251- Catalysis Club

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/>

NSS/NCC/NSO/YRC&CLUBACTIVITIES

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.

Reference

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

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

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, Wiley India Pvt Ltd.
2. <https://www.stewartcalculus.com/>

NATIONAL SERVICE SCHEME (NSS)

Objectives:

The main objectives of this course are:

1. To help learners know about NSS in the context of youth, community and voluntary service.
2. To teach the importance of health, hygiene and sanitation for a healthy Nation.
3. To understand the community in which they work.
4. To identify the problems of the community and involve them in problem- solving.
5. To develop the capacity to meet emergencies and natural disasters.
6. To practice the National integration and social harmony.
7. 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-solving of 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. 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/NCC/NSO/YRC&CLUBACTIVITIES

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 - BMI 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/>

தமிழ் மன்றம்

பாடத்திட்டத்தின் நோக்கங்கள்

- மாணவர்களை சிறந்த மேடைப்பேச்சாளர்களாக உருவாக்குவது
- தாய்மொழியின் மேன்மையை பாதுகாப்பது..

பயிற்சித்திட்டம்

1. பேச்சுக்கலைப் பயிற்சி
2. கவிதை மற்றும் கட்டுரைகள் எழுதும் பயிற்சி
3. அறிவியல் பொறியியல் தொழில்நுட்பங்களைத் தமிழில் எழுதுதல்.
4. பட்டிமன்ற மேடைகளில் பேசும் பயிற்சி.
5. நாட்டுப்புறப்பாடல்கள் பாடுதல் மற்றும் கதைகள் எழுதும் பயிற்சி.

கற்றல் முடிவு

1. பேச்சுக்கலைப் தேர்ச்சி
2. நாட்டுப்புறப்பாடல்கள் பற்றிய புரிதல்

மேற்கோள்கள்

<https://eegarai.darkbb.com/t63483-topic>

<https://poriyari.in/>

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:

5. IRCS/YRC Handbook
6. <https://www.indianredcross.org/youth/Guidelines-for-JYRC-LR.pdf>

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, 1st 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>.

GE3251	NSS//YRC/NSO/Tamil Mandram/Resonance/Eclectic Lingua/Maths Association /Fine Arts Club	L	T	P	C
		0	0	1	1#

NSS/NSO/YRC&CLUBACTIVITIES

S.No	Units	Hours
1	NSS	5
2	NSO	5
3	YRC	5
4	English	5
5	Physics	5
6	Chemistry	5
7	Mathematics	5
8	Tamil Mandram	5
9	Fine Arts Club	5

A students would attend class /Lecture/activity/ in each subject.

The student would be assessed for score of 20 each and course outcome.

To give them an exposure to learning Basic Science and humanities.

**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:

1. Understand the fundamental concepts of Partial differential Equations.
2. Understand the basic concepts of mathematical principles on Fourier & Z- transforms.

- Laplace transform and inverse transform of simple functions, properties, are studied.
- Apply the concept of Understand the concept Fourier series and apply the concept in solving PDE.
- Understand the fundamental concept of the concepts of Solution of difference equations

TEXT BOOKS:

- Veerarajan. T., “Transforms and Partial Differential Equations”, Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
- Grewal. B.S., “Higher Engineering Mathematics”, 42nd Edition, Khanna Publishers, Delhi, 2012.
- 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:

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

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
MA3321.1	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
MA3321.2	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
MA3321.3	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
MA3321.4	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
MA3321.5	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
Avg	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-

No Correlation - Low 1 Medium 2 High 3

OBJECTIVES:

1. To impart a comprehensive exposure to semiconductor devices.
2. To explore the operation and characteristics of Transistors.
3. To evaluate the frequency response of small signal amplifiers.
4. To study about differential and feedback amplifiers.
5. To understand and design of oscillators and power amplifiers.
6. To develop analog application circuits.

UNIT-I: SEMICONDUCTOR DEVICES**9**

PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance - Zener diode characteristics – Schottky barrier diode - Varactor diode –Tunnel diode - LED, Laser diodes

UNIT-II: TRANSISTORS**9**

BJT- structure, operation, characteristics and Biasing, JFET, MOSFET, UJT, SCR, - Structure and Characteristics.

UNIT-III: AMPLIFIERS**9**

BJT small signal model - Analysis of CE, CB, CC amplifiers- FET small signal model and MOSFET small signal model - Analysis of CS, CG and CD – Gain and frequency response.

UNIT-IV: FEEDBACK AND DIFFERENTIAL AMPLIFIERS**9**

Feedback – Voltage / Current, Series, Shunt feedback Amplifiers, Differential amplifier – Common mode and Difference mode analysis, CMRR, Cascade and Cascode amplifier, Single and Double Tuned amplifiers.

UNIT-V: OSCILLATORS AND POWER AMPLIFIERS**9**

Condition for oscillations, Principles and Working of Oscillators: Phase shift, Hartley, Colpitts, Clapp and Crystal oscillators. Efficiency and Analysis of Power amplifiers- Class A-Class B-Class AB-Class C.

TOTAL : 45 Periods**COURSE OUTCOMES:**

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

1. Explain the structure and operation of basic electronic devices.
2. Explore the concepts and operation of Transistors.

3. Analyze the frequency response of BJT and FET amplifiers.
4. Illustrate the operation of differential and negative feedback amplifiers
5. Design of Oscillators and Power amplifiers.
6. Develop analog application circuits.

TEXTBOOKS:

1. David A. Bell, "Electronic Devices and Circuits", Oxford Higher Education press, 5th Edition, 2018.and Applications', Pearson Education, 2007.
2. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 10th Edition, Pearson Education / PHI, 2012.

REFERENCE BOOKS:

1. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", Oxford University Press, 7 th Edition, 2017.
2. Salivahanan and N. Suresh Kumar, Electronic Devices and Circuits, 4th Edition, Mc Graw Hill Education (India) Private Ltd., 2017.
3. Christopher, 'Electronic Devices, Circuits, and Applications 'Springer, 2022..
4. Donald.A. Neamen, "Electronic Circuit Analysis and Design", Tata McGraw Hill, 3 rd Edition,2017.
5. D.Schilling and C.Belove, "Electronic Circuits", McGraw Hill, 3 rd Edition, 2002.
6. Jacob Millman and Arvin Gabel, 'Microelectronics', McGraw Hill, 2017.
7. Electronic Devices & Circuits Theory – Robert Boylestad and Louis Nashelsky, 10th EditionPrentice Hall, 2013.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3362.1	3	3	3	3	-	-	-	-	-	-	-	3	3	3
EC3362.2	3	2	2	3	-	-	-	-	-	-	-	1	2	2
EC3362.3	3	3	3	2	-	-	-	-	-	-	-	2	2	2
EC3362.4	3	3	2	3	-	-	-	-	-	-	-	2	2	2
EC3362.5	3	2	3	2	-	-	-	-	-	-	-	2	2	2
EC3362.6	3	3	3	3	-	-	-	-	-	-	-	2	2	2
AVG	3	3	3	3	-	-	-	-	-	-	-	2	2	2

OBJECTIVES:

1. To understand the basic properties of Signals and Systems.
2. To explore the Fourier transform and Laplace transform in continuous time signal analysis.
3. To analyze continuous time LTI systems using Fourier and Laplace transforms.
4. To apply DTFT and Z-transform in Discrete time signal analysis.
5. To analyze the discrete time LTI systems using DTFT and Z transform.
6. To examine the 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, the student will be able to

1. Emphasize the basic properties of signals and systems used for signal processing
2. Characterize the continuous time signal using Fourier and Laplace transform.
3. Analyze the continuous time LTI systems using Fourier and Laplace transforms.
4. Compute the output of a discrete time LTI system in the time and frequency domains.
5. Estimate the DTFT and Z transform in discrete time signal analysis.
6. Understand the principles of convolution for continuous and discrete time systems.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3363.1	3	3	3	2	-	-	-	-	-	-	-	3	-	-
EC3363.2	3	3	3	3	-	-	-	-	-	-	-	3	-	3
EC3363.3	3	3	2	3	-	-	-	-	-	-	-	3	2	-
EC3363.4	3	3	3	2	-	-	-	-	-	-	-	3	-	3
EC3363.5	3	3	3	3	-	-	-	-	-	-	-	3	-	3
EC3363.6	3	3	3	3	-	-	-	-	-	-	-	3	2	3
Avg	3	3	3	3	-	-	-	-	-	-	-	3	2	3

COURSE OBJECTIVES

1. To introduce electric circuits and its analysis
2. To impart knowledge on solving circuit equations using network theorems
3. To educate the transient response of circuits.
4. To introduce the phenomenon of resonance in coupled circuits.
5. 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.

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

1. To acquire knowledge on Ohm's Law and Kirchhoff 's laws.
2. Ability to determine behavior of the DC and AC circuit by using mesh analysis/ nodal analysis / network theorems
3. Ability to Compute the transient response of first order and second order systems to step and sinusoidal input.
4. To acquire knowledge on line/ phase voltage and currents of the three-phase circuit
5. 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
EE3363.1	1	1									3		-	-
EE3363.2	1		1	2								3	-	-
EE3363.3	1		1		2			3					-	-
EE3363.4	1	1	1								3	1	-	-
EE3363.5	1	1			2								-	-
Avg	1	1	1	2	2			3			3	2	-	-

OBJECTIVES:

- To gain conceptual and basic mathematical understanding of vector analysis on fields.
- To impart knowledge on the basics of static electric field and the associated laws.
- To impart knowledge on the basics of static magnetic field and the associated laws
- To study the significance of Time varying fields.
- To understand the behaviour of the propagation of EM waves.
- To solve problems based on the above concepts.

UNIT- I: INTRODUCTION 9

Electromagnetic model, Units and constants, Vector algebra, Orthogonal coordinate systems and transformations: Cartesian, cylindrical and spherical coordinates, Line, surface and volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Laplacian of a Scalar, Null identities, Helmholtz's theorem.

UNIT- II: ELECTROSTATIC FIELD 9

Coulombs law, Electric field intensity, Gauss law and applications, Electric scalar potential, Conductors in static electric field, Dielectrics in static electric field, Electric flux density, dielectric constant and dielectric strength, Boundary conditions for electrostatic fields, Capacitance, Parallel plate capacitor, Electrostatic energy, Poisson's and Laplace's equations, Current density and Ohm's law, Continuity equation.

UNIT- III: MAGNETOSTATIC FIELD 9

Lorentz force equation, Biot-Savart law and applications, Ampere's circuital law and applications, Vector magnetic potential, Gauss law for magnetic fields, Magnetic flux Density and Field intensity, Magnetization and permeability, Magnetic forces, Torque and Magnetic moment, Boundary conditions for magnetostatic fields,

Magnetic circuits, Inductance, self-inductance, mutual inductance, inductance of solenoid and toroid, Magnetic energy.

UNIT- IV: TIME-VARYING FIELDS AND MAXWELL EQUATIONS 9

Faraday's law, Transformer and Motional Electromotive Forces, Displacement current, Maxwell equations in integral and differential form, Potential functions, Electromagnetic boundary conditions, Poynting vector and theorem, Electromagnetic power flow in coaxial cable.

UNIT- V: UNIFORM PLANE WAVES 9

Uniform Plane wave propagation in free space, dielectrics and good conductors. Group velocity, Wave polarization, Normal incidence and Oblique incidence at a plane conducting boundary, Normal incidence and Oblique incidence at a plane dielectric boundary.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Relate the fundamentals of vector, coordinate system to electromagnetic concepts.
- Analyze the concepts and characteristics of Electrostatic field in material space and solve the boundary conditions.
- Illustrate the concepts and characteristics of Magnetostatic field in material space and solve the boundary conditions.
- Determine the significance of time varying fields.
- Apply EM laws for the propagation of plane waves through different medium.
- Explain the applications of electromagnetic fields and waves.

TEXTBOOKS:

1. David. K.Cheng, "Field and wave Electromagnetics", Second revised edition, Pearson education, 2013.
2. W.H.Hayt and A.Buck, "Engineering Electro Magnetics", Eighth Edition, Mc Graw Hill, 2012.

REFERENCE BOOKS:

1. Mathew.N.O.Sadiku, "Elements of Electromagnetics", Sixth edition, Oxford University Press, 2015.
2. John D Kraus and Daniel A Fleisch, "Electromagnetics with Applications", Fifth edition, Mc Graw Hill, 2010.
3. Edward C. Jordan & Keith G. Balmain, "Electromagnetic waves and Radiating Systems", Second Edition, Prentice-Hall Electrical Engineering Series, 2012.
4. Branislav M.Notaros, "Electromagnetics" Pearson education, 2012.
5. Bhag Singh Guru & Huseyin R. Hiziroglu, "Electromagnetic Field Theory Fundamentals", Second edition, Cambridge University press, 2009.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	
EC3365.1	3	2	1	-	-	-	-	-	-	-	-	-	2	2	1
EC3365.2	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
EC3365.3	3	2	1	2	-	-	-	-	-	-	-	-	1	2	1
EC3365.4	2	2	1	-	-	-	-	-	-	-	-	-	2	2	1
EC3365.5	3	2	1	2	-	-	-	-	-	-	-	-	2	2	1
EC3365.6	2	2	1	2	-	-	-	-	-	-	-	-	2	2	1
Avg	3	2	1	2	-	-	-	-	-	-	-	-	2	2	1

OBJECTIVES:

1. To understand the Digital fundamentals, Boolean algebra and its applications in digital systems.
2. To Practice with the design of combinational digital circuits using logic gates.
3. To bring out the analysis and design procedures for synchronous sequential circuits.
4. To explore the design procedures of an asynchronous sequential circuits.
5. To introduce semiconductor memories and related technology.
6. To design combinational and sequential circuits using HDL.

UNIT-I: DIGITAL FUNDAMENTALS 9

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

UNIT-II: COMBINATIONAL CIRCUIT DESIGN 9

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

UNIT-III: SYNCHRONOUS SEQUENTIAL CIRCUITS 9

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

UNIT-IV: ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

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

UNIT-V: MEMORY DEVICES AND INTRODUCTION TO HDL PROGRAMMING

9

Basic memory structure- ROM-PROM-EPROM-EEPROM, RAM – Static and Dynamic RAM- Programmable Logic Devices-Programmable Logic Array (PLA) – Programmable Array Logic (PAL). Introduction to HDL: Behavioral – data flow, and structural description, Examples for Combinational and Sequential circuits-Adders-Multiplexer-demultiplexer- Encoder-Decoder-Flipflops-Shift registers.

45 PERIODS

PRACTICAL EXERCISES:

30 PERIODS

1. Design of adders and subtractors & code converters.
2. Design of Multiplexers & Demultiplexers.
3. Design of Encoders and Decoders.
4. Design of Magnitude Comparators.
5. Design and implementation of counters using flip-flops.
6. Design and implementation of shift registers.

TOTAL:75 PERIODS

COURSE OUTCOMES:

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

1. Use Boolean algebra and simplification procedures relevant to digital logic.
2. Apply the logical knowledge in the design of combinational circuits.
3. Analyze the concepts of sequential circuits and design sequential circuits in terms of state machines.
4. Design and analyze asynchronous sequential circuits.
5. Build logic gates and use programmable devices.
6. Implement combinational and sequential circuits using HDL.

TEXTBOOKS:

1. M. Morris Mano and Michael D. Ciletti, "Digital Design", 5th Edition, Pearson, 2014.
2. Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
3. Samir Palnitkar – "Verilog HDL A guide to Digital design and Synthesis", 2nd Edition, Prentice Hall, 2003.

REFERENCE BOOKS:

1. S.Salivahanan and S.Arivazhagan "Digital Electronics", First Edition, Vikas Publishing House pvt. Ltd., 2012.

2. Thomas L. Floyd, "Digital Fundamentals", 10 Edition, Pearson Education Inc, 2011.
3. Anil K.Maini, "Digital Electronics", Wiley, 2014
4. A.Anand Kumar "Fundamentals of Digital Circuits", 4th Edition, PHI Learning Private Limited, 2016.
5. Soumitra Kumar Mandal, "Digital Electronics", McGraw Hill Education Private Limited, 2016.
6. Nazeih M.Botros "HDL programming VHDL and Verilog", Dreamtech Press, Reprint Edition 2009.

WEB REFERENCES:

1. <https://nptel.ac.in/courses/117103064>
2. <https://nptel.ac.in/courses/108103179>

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3366.1	3	2	2	-	-	-	-	-	3	-	-	3	3	2
EC3366.2	2	3	3	2	2	-	-	-	3	-	-	1	2	2
EC3366.3	2	3	3	3	2	-	-	-	3	-	-	2	2	2
EC3366.4	2	3	3	3	2	-	-	-	3	-	-	2	2	2
EC3366.5	2	2	1	1	2	-	-	-	3	-	-	2	2	2
EC3366.6	2	3	3	2	3	-	-	-	3	-	-	2	2	2
AVG	2	3	3	2	2	-	-	-	3	-	-	2	2	2

LAB REQUIREMENTS FOR A BATCH OF 60 STUDENTS, 2 STUDENTS / EXPERIMENT:

S.NO	EQUIPMENTS FOR DIGITAL LAB	REQUIRED
1.	Dual power supply/ single mode powersupply.	30 Nos
2.	IC Trainer Kit.	30 Nos
3.	Bread Boards	30 Nos
4.	Seven segment display	30 Nos
5.	Multimeter	10 Nos
6.	ICs each 50 Nos. 7400/ 7402 / 7404 / 7486 / 7408 / 7432 / 7483 / 74150 / 74151 / 74147 / 7445 / 7476/7491/ 555 / 7494 / 7447 / 74180 /7485 / 7473 / 74138 / 7411 / 7474	-

OBJECTIVES:

1. To learn the characteristics of PN Junction diode.
2. To learn the characteristics of Zener diode.
3. To understand the operation of rectifiers and filters.
4. To study the characteristics of BJT and FET amplifiers.
5. To analyse the operation of power amplifiers.
6. To apply knowledge to develop analog application circuits.

LIST OF EXPERIMENTS

- 1 Characteristics of PN Junction Diode and Zener diode
- 2 Full Wave Rectifier with Filters.
- 3 Design of Zener diode Regulator
- 4 BJT Common Emitter input-output Characteristics.
- 5 FET Drain current and Transfer Characteristics.
- 6 Frequency response of CE and CS amplifiers.
- 7 Frequency response of CC and CD amplifiers
- 8 Frequency response of Cascade Amplifier.
- 9 CMRR measurement of Differential Amplifier.
- 10 Class A Power Amplifier.
- 11 Class C Power Amplifier.

TOTAL: 45 Periods**COURSE OUTCOMES:**

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

1. Explain the characteristics of PN Junction Diode.
2. Understand the operation of Zener diode.
3. Evaluate the performance of Full Wave Rectifier with Filters.
4. Analyze the AC parameters of BJT and FET amplifiers.
5. Illustrate the Operation of power amplifiers.
6. Develop an analog application circuits.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:	
1	CRO/DSO (30 MHz) – 15 Nos.
2	Signal Generators / Function Generators (3 MHz) – 15 Nos.
3	Dual Regulated Power Supplies (0-30 v) - 15 Nos.
4	Bread Boards - 15 Nos.
5	Bread Boards - 15 Nos.
6	SPICE Simulator

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
EC3367.1	3	3	2	3	2	1	-	-	3	-	-	2	2	1
EC3367.2	3	3	2	3	2	1	-	-	3	-	-	2	2	1
EC3367.3	3	2	2	3	1	1	-	2	3	-	-	2	3	2
EC3367.4	3	3	2	3	3	2	2	2	3	-	-	2	3	2
EC3367.5	3	2	2	3	2	2	2	2	3	-	-	2	3	2
EC3367.6	3	2	3	3	3	2	2	2	3	3	2	2	3	3
Avg	3	3	2	3	2	2	2	2	3	3	2	2	3	2

Low, 2- Medium, 3- High, '-' – No correlation

COURSE OBJECTIVES:

- To impart knowledge on the following topics
- To gain hands on experience in Kirchhoff's laws.
- To gain knowledge on basic circuit theorems
- To learn the characteristics of basic electronic devices such as Diode.
- To learn the characteristics of BJT, FET, SCR.
- To learn the characteristics Full wave and Half wave rectifier using Pspice.

LIST OF EXPERIMENTS:

1. Experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.
2. Experimental verification of electrical circuit problems using Thevenin's theorem.
3. Experimental verification of electrical circuit problems using Norton's theorem.
4. Experimental verification of electrical circuit problems using Superposition theorem.
5. Experimental verification of Maximum Power transfer Theorem.
6. V-I Characteristics of PN Junction Diode.
7. V-I Characteristics of Zener diode.
8. Experimental verification of Common Emitter input-output Characteristics.
9. Verification of Input and Output Characteristics Common Base Configuration using Pspice.
10. Experimental verification of FET Characteristics.
11. Experimental verification of SCR Characteristics.
12. Half wave Rectifier and Full wave Rectifier using Pspice.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- Ability to Understand and Kirchhoff's laws
- Ability to understand the basic circuit theorems.
- Ability to understand basic electronic devices such as Diode.
- Ability to understand concept of BJT, FET, SCR.
- Ability to concept characteristics Full wave and Half wave rectifier using Pspice.

EE3369	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
EE3369.1	3	3	1					1	2		2	2	3			2
EE3369.2	3	3	2	2				1	2		2	2	2	2		2
EE3369.3	3	3	2	2				1	2		2	2	2	2		2
EE3369.4	3	3	3	1				1	2		2	2	3			2
EE3369.5	3	3	1	2	3			1	2		2	2	2	2		2
Avg	3	3	2	2	3	-	-	1	2	-	2	2	2	2	-	2

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1. Regulated Power Supply 0 – 15 V D.C	10
2. BC 107, BC 148, 2N2646, BFW10	10
3. 1N4007, Zener diodes	10
4. Oscilloscope (20 MHz)	10
5. PC	10
6. Circuit Simulation Software (e-Sim/ Scilab/ Pspice / MATLAB / other Equivalent software Package)	Min.10 users
7. AC/DC - Voltmeters	10
8. Ammeters	10
9. Multi-meters	10
10. Decade Resistance Box, Decade Inductance Box, Decade Capacitance Box	6.nos each
11. Circuit Connection Boards	10
12. Resistors, Inductors, Capacitors of various capacities	As Required

REFERENCES:

- R1. Laboratory Manual

OBJECTIVES:

- To understand the basic concepts of one dimensional random variables and special probability distribution
- To understand the basic concepts of two dimensional random variables correlation and linear regression
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the concept of correlation and spectral densities.
- To introduce the basic notions of linear system with random inputs

UNIT-I: RANDOM VARIABLES & DISTRIBUTIONS 6L

Discrete and continuous random variables - Two dimensional random variables-Joint probability distributions – Marginal and conditional distributions.

UNIT-II: TWO DIMENSIONAL RANDOM VARIABLES 6L

Two dimensional random variables Joint distributions – Marginal and conditional distributions – correlation- Regression

UNIT-III: RANDOM PROCESSES 6L

Classification – Stationary process – Markov chain- Poisson process.

UNIT-IV: CORRELATION AND SPECTRAL DENSITIES 6L

Auto correlation function - Properties –Power spectral density-Properties.

UNIT-V: LINEAR SYSTEM WITH RANDOM INPUTS 6L

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

TOTAL: 30L PERIODS

OUTCOMES:

- Understand the basic concepts of one dimensional random variables and probability distributions apply them to model engineering problems.

- Understand the basic concepts of two dimensional random variables and correlation regression and apply them to model engineering problems
- Apply the concept of random processes in engineering disciplines.
- Understand and apply the concept of correlation and spectral densities.
- Apply the concepts of random processes in linear system with random input

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. T.Veerarajan, Probability, Statistics and Random processes, Tata McGraw-Hill, 5th Edition, 2008

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. Gross, D., Shortle, J.F, Thompson, J.M and Harris. C.M., "Fundamentals of Queueing Theory", Wiley Student 4th Edition, 2014
4. J.Medhi, Stochastic Processes, New Age International (P) Ltd., Second Edition, 1994.
5. P. Sivaramakrishna Das, C. Vijayakumari, " Probability and Random Processes", Pearson Publications, 2nd Edition 2016

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	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

OBJECTIVES:

1. To learn IC classification, basic building blocks and characteristics of linear integrated circuits.
2. To study and design Instrumentation amplifier and wave shaping Circuits.
3. To Classify and design the linear and non-linear applications of operational amplifiers.
4. To analyze the applications of analog multipliers, PLL and VCO.
5. To illustrate the functions of ADC and DAC.
6. To infer the concepts of waveform generation and introduce some special function ICs.

UNIT-I: BASICS OF IC AND OPERATIONAL AMPLIFIERS 9

IC classification, fundamentals of monolithic IC technology, Realization of monolithic ICs and packaging. Current mirror and current sources, Current sources as active loads, Ideal Operational Amplifier Characteristics - operational amplifier stages. DC and AC performance characteristics of Op-Amp, Open and closed loop configurations.

UNIT-II: APPLICATIONS OF OPERATIONAL AMPLIFIERS 9

Scale Changer, Phase Shift Circuits, Voltage Follower, adder, subtractor, Integrator, Differentiator, Instrumentation amplifier, V-to-I and I-to-V converters, Logarithmic amplifier, Comparators, Astable and Monostable Multivibrators, Schmitt trigger, clipper and clamper, Low and high pass filters.

UNIT-III: ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair, analog multiplier ICs and their applications, Voltage controlled oscillator, Operation of the basic PLL, closed loop analysis, Monolithic PLL IC 565, applications of PLL.

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

D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type.

UNIT-V: WAVEFORM GENERATORS AND SPECIAL FUNCTION ICs 9

Sine-wave generators, Triangular wave generator, Saw-tooth wave generator, IC555 Timer- Astable and Monostable Multivibrators, IC Voltage regulators, IC 723 general purpose regulator, Frequency to Voltage and Voltage to Frequency converters, Isolation Amplifier.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

1. Understand IC classification, IC technology and Realization of monolithic ICs
2. Describe the DC and AC characteristics of operational amplifiers and its effect on output and their compensation techniques.
3. Design operational amplifier circuits for linear and non-linear applications.
4. Explain the working and applications of timer, VCO and PLL ICs.
5. Choose appropriate A/D and D/A converters for signal processing applications.
6. Illustrate the function of application specific ICs such as Voltage regulators and Isolation Amplifier.

TEXTBOOKS:

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", New Age International Pvt. Ltd., 2018, Fifth Edition. (Unit I – V).
2. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, Tata Mc Graw-Hill, 2016 (Unit I – V).

REFERENCE BOOKS:

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall Pearson Education, 2015.
2. Robert F.Coughlin, Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", Sixth Edition, PHI, 2001.
3. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", TMH, 2nd Edition, 4th Reprint, 2016.
4. Gray and Meyer, "Analysis and Design of Analog Integrated Circuits", 5th Wiley International, 5th Edition, 2009.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO's	PROGRAM OUTCOMES												PROGRAM SPECIFIC OUTCOMES	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3462.1	3	3	3	3	2	-	-	-	-	-	-	2	1	1
EC3462.2	3	2	2	3	2	-	-	-	-	-	-	2	1	1
EC3462.3	3	2	3	2	2	-	-	-	-	-	-	1	2	2
EC3462.4	3	2	2	2	2	-	-	-	-	-	-	1	1	1
EC3462.5	2	2	3	2	2	-	-	-	-	-	-	1	2	2
EC3462.6	2	2	2	2	2	-	-	-	-	-	-	1	2	2
Avg	3	2	3	2	2	-	-	-	-	-	-	1	3	3

OBJECTIVES:

1. To explore the aspects of communication and its effects
2. To introduce the concepts of amplitude modulation.
3. To discuss angle modulation and their spectral characteristics.
4. To understand the properties of random process
5. To know the effect of noise on communication systems.
6. To study the concepts of pulse analog modulation.

UNIT-I: AMPLITUDE MODULATION 9

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

UNIT-II: ANGLE MODULATION 9

Phase and frequency modulation, Narrow Band and Wide band FM – Modulation index, Spectra, Power relations and Transmission Bandwidth - FM modulation – Direct and Indirect methods, FM Demodulation –Foster Seeley FM discriminator– FM receiver.

UNIT-III: RANDOM PROCESS 9

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

UNIT-IV: NOISE CHARACTERIZATION 9

Noise sources – Noise figure, Noise temperature and Noise bandwidth – Noise in cascaded systems. Representation of Narrow band noise –In-phase and

quadrature, Envelope and Phase – Noise performance analysis in FM systems – Threshold effect, Capture effect, Pre-emphasis and de-emphasis for FM.

UNIT-V: PULSE ANALOG MODULATION 9

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

TOTAL : 45 Periods

COURSE OUTCOMES:

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

1. Discuss the nature and scope of communication
2. Identify the fundamental concepts and components of amplitude modulation.
3. Design angle modulated communication systems.
4. Emphasize the basic concepts of Random Process to the design of Communication systems.
5. Estimate the noise performance of AM and FM systems.
6. Understand the importance of sampling and quantization in communication systems.

TEXTBOOKS:

1. George Kennedy, Bernard Davis, USA S R M Prasanna, Electronic Communication Systems, McGraw Hill Education; Sixth edition, 2017.
2. Wayner Tomasi, Electronic Communication System, 5th Edition, Pearson Education, 2008.
3. J.G. Proakis, M.Salehi, "Fundamentals of Communication Systems", Pearson Education 2014.
4. Simon Haykins," Communication Systems", Wiley, 5th Edition, 2009.

REFERENCE BOOKS:

1. B.P. Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011.
2. D.Roody, J.Coolen, Electronic Communications, 4th edition PHI 2006.

3. H P Hsu, Schaum Outline Series - "Analog and Digital Communications" TMH 2006.
4. Couch.L, "Modern Communication Systems", Pearson, 2001.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3463.1	2	2	1	1	-	1	-	-	-	-	2	2	2	-
EC3463.2	3	3	2	2	-	1	-	-	-	-	-	3	2	3
EC3463.3	1	2	3	2	-	-	-	-	-	-	-	3	1	3
EC3463.4	3	3	2	3	-	-	-	-	-	-	-	3	2	2
EC3463.5	1	2	2	2	-	-	-	-	-	-	-	2	2	3
EC3463.6	-	1	-	2	-	-	-	-	-	-	2	3	1	2
Avg	2	2	2	2	-	1	-	-	-	-	2	3	1	2

OBJECTIVES:

1. To understand the Architecture of 8086 microprocessor.
2. To study about multiprocessor configurations and bus structure.
3. To learn the design aspects of I/O and Memory Interfacing circuits.
4. To interface microprocessors with supporting chips.
5. To study the Architecture of 8051 microcontroller.
6. 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

1. Acquire the knowledge on architectural concepts of 8086 microprocessor
2. Understand bus interfacing systems and analyze the Coupled communication systems.
3. Explore and design the interface of I/O circuits.
4. Design the interfacing applications with microprocessor.
5. Formulate and implement 8051 microcontroller based systems.
6. 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 DesignII, 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 CII, 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. Douglas V.Hall, —Microprocessors and Interfacing, Programming and HardwareII, 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
EC3464.1	2	1	2	1	3	1	-	-	-	-	-	2	2	1
EC3464.2	2	2	2	1	-	-	-	-	-	-	-	2	2	1
EC3464.3	2	1	2	1	3	1	-	-	-	-	-	2	2	1
EC3464.4	2	1	2	1	3	1	-	-	-	-	-	2	2	1
EC3464.5	2	1	2	3	3	1	-	-	-	-	2	2	2	1
EC3464.6	2	1	2	3	3	1	-	-	-	-	3	2	2	1
Avg	2	1	2	2	3	1	-	-	-	-	3	2	2	1

UNIT V STATE VARIABLE ANALYSIS

9

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. To represent and develop systems in different forms using the knowledge gained.
2. To analyses the system in time and frequency domain.
3. To discuss the effect of PID controller in closed loop systems.
4. To analyses the stability of physical systems and construct compensator for the linear systems.
5. Ability to design State variable representation of physical systems.

TEXT BOOKS:

1. I.J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2021.
2. Benjamin C. Kuo, " Automatic Control systems", Wiley,2014.
3. NagoorKaniA,"Control Systems Engineering", CBS Publishers and distributors, 2017.

REFERENCES:

1. M.Gopal, "Control System: Principle and design", McGraw Hill Education,2012.
2. Katsuhiko Ogata, "Modern Control Engineering", Pearson, 2015.
3. Norman S. Nise, Control Systems Engineering, 4th Edition, John Wiley, New Delhi, 2007.
4. Samarajit Ghosh, Control systems, Pearson Education, New Delhi, 2017.

MAPPING OF COs WITH POs AND PSOs

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

GE 3451

NCC Credit Course Level - I
(Common to Army, Navy & Air)

L T P C
3 0 0 3

Objective:

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

Unit I Introduction to NCC 9

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 9

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 9

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 9

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 9

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: 45 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:**

1. Understand their roles and responsibilities
2. Demonstrate the knowledge of human values and morals
3. Actively participate in social service and development activities
4. Understand the importance of disaster management
5. 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

OBJECTIVES:

1. To calculate the DFT using FFT
2. To design the IIR Filter.
3. To conceptualize the FIR Filter.
4. To implement the filters in standard structure.
5. To assess the finite word length effects.
6. To explore the architecture of a programmable digital signal processor.

UNIT-I: DISCRETE FOURIER TRANSFORM 9

Definition of Discrete Fourier Transform (DFT) -properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Filtering long data sequences - overlap save and overlap add method. Fast Fourier transform (FFT)- Radix-2 Decimation-in-time (DIT), Decimation-in-frequency (DIF)

UNIT-II: INFINITE IMPULSE RESPONSE FILTERS 9

Butterworth filters, Chebyshev filters. Design of IIR filters from Analog filters (LPF, HPF, BPF, BRF) - Approximation of derivatives, Impulse invariance method, Bilinear transformation. Structure of IIR filter - direct form I, direct form II, Cascade, parallel realizations.

UNIT-III: FINITE IMPULSE RESPONSE FILTERS 9

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

UNIT-IV: FINITE WORD LENGTH EFFECTS 9

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

UNIT-V: INTRODUCTION TO DIGITAL SIGNAL PROCESSORS 9

DSP functionalities - DSP architecture – Fixed and Floating point architecture (TMS320C5X and TMS320C6X) principles – Programming – Application examples

TOTAL : 45 PERIODS

PRACTICAL EXERCISE

MATLAB / EQUIVALENT SOFTWARE PACKAGE/ DSP PROCESSOR BASED IMPLEMENTATION

1. Generation of Elementary Discrete Time Signals.
2. Linear and Circular Convolution.
3. Computation of DFT.
4. Computation of FFT.
5. Design of FIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operation.
6. Design of Butterworth and Chebyshev IIR filters (LPF/HPF/BPF/BSF) and demonstrate the filtering operations.
7. Study of architecture of Digital Signal Processor.
8. Perform MAC operation using various addressing modes.
9. Generation of various signals and random noise.
10. Implement an Up-sampling and Down-sampling operation in DSP Processor.

TOTAL : 30 Periods

COURSE OUTCOMES:

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

1. calculate the Fast Fourier Transforms by DIT and DIF techniques
2. design IIR Filters for the given specifications.
3. conceptualize FIR Filters with the given specifications
4. sketch the Filter in standard structures like Direct Form and Parallel Form
5. analyze performance degradation of digital signal processing systems due to finite precision
6. interpret the architectural details of fixed and floating digital signal processor

TEXTBOOKS:

1. J.G. Proakis and D.G. Manolakis, 'Digital Signal Processing Principles, Algorithms and Applications', Pearson Education, 2007.
2. Bhaskar, M. and Venkataramani, B, "Digital signal processors: architecture, programming and applications", Tata McGraw-Hill Pub, 2002.

REFERENCE BOOKS:

1. A.V.Oppenheim, R.W. Schaffer and J.R. Buck, "Discrete Time Signal Processing", , Pearson, 8th Indian Reprint, 2004.

2. Nagoorkani A, Digital Signal Processing, Tata McGraw Hill Publishing, 2012
3. Salivahanan R, Digital Signal Processing, McGraw Hill Publishing, 2019, 4th edition
4. Palani S and Kalaiyarasi K, Principles of Digital Signal Processing, Ane Books Pvt Ltd, 2015, 2nd edition.
5. NPTEL Course: <https://nptel.ac.in/courses/117102060>

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
EC3465.1	3	3	3	3	-	-	-	-	2	-	-	-	2	3
EC3465.2	3	3	3	3	-	-	-	-	2	-	-	-	2	3
EC3465.3	3	3	3	3	-	-	-	-	2	-	-	-	2	3
EC3465.4	3	3	3	3	-	-	-	-	2	-	-	-	2	2
EC3465.5	3	3	3	3	-	-	-	-	2	-	-	-	3	2
EC3465.6	3	3	3	3	-	-	-	-	2	-	-	-	3	2
Avg	3	3	3	3	-	-	-	-	2	-	-	-	2	3

LIST OF EQUIPMENT FOR A BATCH OF 60 STUDENTS 3 STUDENTS PER EXPERIMENT:

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

OBJECTIVES:

1. To infer the basics of linear integrated circuits and available ICs
2. To analyze the characteristics of the operational amplifier.
3. To apply operational amplifiers in linear and nonlinear applications.
4. To understand the need for PCB Design, steps involved in PCB Design and Fabrication process.
5. To identify the design procedural steps for PCB design using OrcAD tool.
6. To Design an electronic printed circuit board for a specific application using industry standard software

OP-AMP BASED EXPERIMENTS: DESIGN AND TESTING OF

- 1 Inverting, Non-inverting Amplifier using Op-Amp.
- 2 Integrator and Differentiator using Op-Amp.
- 3 Instrumentation amplifier using Op-Amp.
- 4 Active low-pass and High-pass Filters using Op-Amp.
- 5 Bistable multivibrators and Schmitt Trigger using Op-Amp.
- 6 Astable and monostable multivibrators using NE555 Timer.
- 7 PLL characteristics

PCB DESIGN EXPERIMENTS USING ORCAD TOOL

- 1 Introduction to PCB Design, Fabrication & Assembly Process and Transmission lines, crosstalk, and its effects using OrCAD.
- 2 Using OrCAD tool, Practice the Basic RC Circuit with following PCB Design steps.
Schematic Design: Familiarization of the Schematic Editor, Schematic creation, Annotation, Netlist generation
Layout Design: Familiarization of Footprint Editor, Mapping of components, Creation of PCB layout Schematic
Create new schematic components
Create new component footprints.
10. Design and fabricate a PCB for Regulated power supply with filter and regulation sections

TOTAL: 45 Periods

COURSE OUTCOMES:

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

- Construct amplifiers using operational amplifiers.
- Analyze the frequency response of the filters using operational amplifier.
- Examine the working of PLL characteristics and multivibrators
- Understand the steps involved in schematic, layout, fabrication, and assembly process of PCB design.
- Design (schematic and layout) PCB for analog circuits, digital circuits, and mixed circuits.
- Test (schematic and layout) and fabricate PCB for simple circuits.

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
EC3466.1	3	2	1	2	3	2	-	-	2	3	3	2	3	2
EC3466.2	3	2	2	2	2	1	-	-	2	3	3	2	3	2
EC3466.3	3	2	2	2	2	1	-	-	2	3	3	2	3	2
EC3466.4	3	2	1	2	2	1	-	-	2	3	3	2	3	2
EC3466.5	3	2	2	2	2	1	-	-	2	3	3	2	3	2
EC3466.6	3	2	2	2	2	1	-	-	2	3	3	2	3	2
Avg	3	2	2	2	2	1	-	-	2	3	3	2	3	2

1- Low, 2- Medium, 3- High, '-' – No correlation

LAB REQUIREMENT FOR A BATCH OF 30 STUDENTS:		
S.NO	EQUIPMENTS	QUANTITY
1.	70MHz DSO with built in 4-bit pattern generator and 50 MHz AFG	15 Nos
2.	Programmable Triple o/p Power Supplies (0 –30V/ 3A) (0-30V/3A) (0-5V/3A)	15 Nos
3.	Digital Multimeter	15 Nos
4.	Digital LCR Meter	2 Nos
5.	Standalone desktops PC	15 Nos
6.	Transistor/MOSFET (BJT-NPN-PNP and NMOS/PMOS)	50 Nos
7.	IC Tester	5 Nos
8.	Copper cladded base board	15 Nos
9.	Hand Drilling machine	15 Nos
10.	Soldering guns	15 Nos
11.	Assorted electronic components for making circuits	50 Nos
12.	OrCAD/ allegro/Altium or equivalent software	15 Users
13.	Copper solvent	as required

OBJECTIVES:

1. To develop assembly Language program for 8086 Microprocessor.
2. To introduce string manipulation instructions for 8086 Microprocessor.
3. To understand the working of peripheral devices.
4. To enumerate programs to interface memory, I/O's with processor.
5. To develop assembly Language program for 8051 Microcontroller.
6. 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,

1. Write ALP Programs for Arithmetic operations and Logical operations.
2. Express the programming logics for code conversion
3. Analyze the working principle of ADC and DAC.
4. Interface different I/O's with processor and Generate waveforms using 8086
5. Execute microcontroller programs in 8051.
6. 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
EC3467.1	3	-	2	-	3	-	-	-	2	2	-	3	2	2
EC3467.2	2	-	3	-	3	-	-	-	2	2	-	2	2	-
EC3467.3	2	-	3	-	3	-	-	-	2	2	-	2	2	-
EC3467.4	1	2	3	-	3	-	-	-	1	2	-	2	2	-
EC3467.5	1	2	3	-	3	-	-	-	2	2	-	2	2	2
EC3467.6	1	2	3	2	3	2	2	2	2	2	-	2	2	2
AVG	2	2	3	2	3	2	2	2	2	2	-	2	2	2

OBJECTIVES:

- To understand the basic principles of information theory and source coding techniques.
- To learn the different waveform coding schemes.
- To explore the various baseband transmission schemes.
- To apply the Band pass signaling schemes in digital communication.
- To estimate the BER of various digital Modulation schemes
- To acquire knowledge in the fundamentals of channel coding.

UNIT-I: INFORMATION THEORY 9

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

UNIT-II: WAVEFORM CODING AND REPRESENTATION 9

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

UNIT-III: BASEBAND TRANSMISSION AND RECEPTION 9

ISI – Nyquist criterion for distortion less transmission – Raised cosine spectrum – Correlative coding – Eye pattern – Receiving Filters - Matched Filter, Correlation receiver.

UNIT-IV: DIGITAL MODULATION SCHEME 9

Gram-Schmidt orthogonalization procedure, ASK, FSK, BPSK, QPSK, QAM – Generation, detection, PSD & BER of coherent system and Non-Coherent Systems.

UNIT-V: ERROR CONTROL CODING 9

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

TOTAL : 45 Periods

COURSE OUTCOMES:

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

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

TEXT BOOKS:

1. Simon Haykin, Digital Communications, student edition, Wiley India, 2017.
2. B.P.Lathi, "Modern Digital and Analog Communication Systems" 4th Edition, Oxford University Press 2017.

REFERENCES:

1. John. G. Proakis, Digital Communication, 5th edition, Pearson Education, Noida, India, 2014.
2. B. Sklar, "Digital Communication Fundamentals and Applications", 3rd Edition, Pearson Education, 2020.
3. Herbert Taub and Donald L Schilling, Principles of Communication Systems, 4th edition, Tata McGraw Hill, New Delhi, 2017.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3561.1	3	3	3	2	-	-	-	-	-	-	-	2	2	-
EC3561.2	3	2	3	-	-	-	-	-	-	-	-	2	3	-
EC3561.3	3	2	2	-	-	-	-	-	-	-	-	2	2	2
EC3561.4	3	3	2	-	-	-	-	-	-	-	-	2	3	3
EC3561.5	3	3	3	3	-	-	-	-	-	-	-	2	2	2
EC3561.6	3	3	2	3	-	-	-	-	-	-	-	2	3	2
AVG	3	3	3	3	-	-	-	-	-	-	-	2	3	2

EC3562	TRANSMISSION LINES AND WAVEGUIDES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concept of transmission lines types, various line parameters, waveguide types and resonators.
- To characterize and analyze the transmission line parameters for various frequencies.
- To analyze impedance matching techniques and to obtain solution using smith-charts.
- To study the principles and modes of wave propagation in waveguides.
- To explore the characteristics and properties of rectangular and circular waveguides.
- To acquire knowledge about Q factor in waveguides.

UNIT-I: FUNDAMENTALS 9

Introduction - Types of transmission lines - General theory of transmission line - Line constants – Transmission line equation - Physical significance of the equations - The Infinite line - Distortion in a line - Distortion less line -Telephone cables - Loading of lines - Types of loading - Campbell’s formula - General equation for line with any termination - Input impedance - Open and Short-circuited line.

UNIT-II: RADIO FREQUENCY TRANSMISSION LINES 9

Line approximations - Parameters of open wire line at radio frequency, parameters of coaxial lines at radio frequencies, constants for the line of zero dissipation - Voltages and Currents on the dissipation-less lines - input impedance of a lossless line - Wavelength and velocity of propagation - Reflection phenomena - Line losses - Return loss - reflection loss- insertion loss - Reflection coefficient, Reflection factor, Standing wave ratio, Input impedance in terms of reflection coefficient.

UNIT-III: TRANSMISSION LINE SECTIONS AND IMPEDANCE MATCHING TECHNIQUES 9

Types of transmission line sections - Half wave line - Quarter wave line - Properties of quarter wave transformer - Impedance matching - Single and double stub matching- Smith chart and its Applications.

UNIT-IV: WAVE PROPAGATION AND CHARACTERISTICS IN PARALLEL PLANES 9

Waves between parallel planes - Transverse electric waves -Transverse magnetic waves - Characteristics of TE and TM waves - Transverse electromagnetic waves - Velocities of propagation - Attenuation in parallel plane waves - Wave impedance.

UNIT-V: GUIDED WAVES AND WAVE GUIDE THEORY 9

Rectangular wave guides - TE and TM waves in rectangular wave guides - Dominant mode - Cut off frequency in wave guides - Impossibility of TEM waves in wave guides - Circular wave guides- TE and TM waves in circular wave guides - Attenuation factor and Q of wave guides.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the fundamental concepts of wave propagation in Transmission Lines and Wave Guides.
- Analyze the line parameters and various losses in transmission lines.
- Apply Smith chart for line parameters and impedance matching calculations.
- Emphasize the electromagnetic wave propagation in the guided medium.
- Assess the characteristics of parallel plane, rectangular wave guides and Circular waveguides.
- Comprehend the Q-factor in the waveguides.

TEXT BOOKS:

1. John D Ryder, "Networks Lines and Fields" 2nd Edition, Pearson Publishers, 2015.
2. Edward Jordan and K.G.Balmain, "Electromagnetic waves and radiating system", 4th Edition, PHI, 2016.

- Umeshsinha, "Transmission lines and networks", 8th Edition, Sathya Prakashan Publishers, 2010

REFERENCES:

- David K. Cheng, "Field and wave Electromagnetics", 2nd Edition, Pearson Publishers, 2014.
- David M. Pozar, "Microwave Engineering", 3rd Edition, John Wiley, 2011.
- Seth S.P., "Elements of Electromagnetic Fields", 2nd Edition, Dhanpat Rai and Sons, 2007.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3562.1	2	2	1	1	-	-	-	-	-	-	-	1	1	2
EC3562.2	2	2	1	2	-	-	-	-	-	-	-	2	2	2
EC3562.3	2	2	2	3	-	-	-	-	-	-	-	2	2	2
EC3562.4	2	2	2	2	-	-	-	-	-	-	-	1	2	2
EC3562.5	2	1	2	2	-	-	-	-	-	-	-	1	2	2
EC3562.6	2	3	2	1	-	-	-	-	-	-	-	2	2	2
AVG	2	3	2	2	-	-	-	-	-	-	-	2	2	2

OBJECTIVES:

- To understand the fundamentals of IC technology components and their characteristics.
- To learn the concepts of combinational logic circuits and design principles.
- To design the sequential logic circuits with clocking strategies.
- To explore the integration of ASIC Design implementation and testing.
- To apply the concept for making Memory Architecture and building blocks
- To estimate the power, speed, and area of the implemented chips.

UNIT-I: MOS TRANSISTOR PRINCIPLES 9

MOS logic families (NMOS and CMOS), Ideal and Non-Ideal IV Characteristics, CMOS devices. MOS(FET) Transistor Characteristic under Static and Dynamic Conditions, Technology Scaling, power consumption.

UNIT-II: COMBINATIONAL LOGIC CIRCUITS 9

Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's constant, Static Logic Gates, Dynamic Logic Gates, Pass Transistor Logic, Power Dissipation, Low Power Design principles.

UNIT-III: SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES 9

Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Nonbistable Sequential Circuits. Clocking strategies of Digital Systems, Synchronous Design, Self-Timed Circuit Design.

UNIT-IV: INTERCONNECT, MEMORY ARCHITECTURE AND ARITHMETIC CIRCUITS 9

Interconnect Parameters – Capacitance, Resistance, and Inductance, Electrical Wire Models, Sequential digital circuits: adders, multipliers, comparators, shift

registers. Logic Implementation using Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks, Memory Core and Memory Peripherals Circuitry

UNIT-V: ASIC DESIGN AND TESTING 9

Microchip design process & issues in testing and verification of complex chips. ASIC Design Flow, need for test benches, Writing test benches in Verilog HDL, Automatic test pattern generation, Design for testability, Scan design: Test interface and boundary scan.

TOTAL: 45 Periods

COURSE OUTCOMES:

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

- Emphasize the in-depth knowledge of MOS technology
- Understand the concepts of Combinational Logic Circuits and Design Principles
- Design Sequential Logic Circuits and Clocking Strategies
- Propose the Memory architecture and building blocks for Arithmetic System
- Propose the ASIC Design Process flow and Testing
- Write test benches and test the design using Scan based approaches.

TEXT BOOKS:

1. Jan D Rabaey, Anantha Chandrakasan, "Digital Integrated Circuits: A Design Perspective", PHI, 2016. (Units II, III and IV).
2. Neil H E Weste, Kamran Eshraghian, "Principles of CMOS VLSI Design: A System Perspective," Addison Wesley, 2009. (Units - I, IV).
3. Michael J Smith," Application Specific Integrated Circuits, Addison Wesley, (Unit - V)
4. Samir Palnitkar," Verilog HDL: A guide to Digital Design and Synthesis", Second Edition, Pearson Education,2003. (Unit - V)

REFERENCES:

1. Parag K.Lala, "Digital Circuit Testing and Testability", Academic Press, 1997.
2. D.A. Hodges and H.G. Jackson, Analysis and Design of Digital Integrated Circuits, International Student Edition, McGraw Hill 1983
3. P.Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and Techniques", Kluwer Academic Publishers,2001
4. Samiha Mourad and Yervant Zorian, "Principles of Testing Electronic Systems", Wiley 2000
5. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers,2000

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3563.1	3	-	2	-	3	-	-	-	-	-	-	3	2	2
EC3563.2	2	-	3	-	3	-	-	-	2	-	-	2	2	-
EC3563.3	2	-	3	-	3	-	-	-	2	-	-	2	2	-
EC3563.4	1	2	3	-	3	-	-	-	2	-	-	2	2	-
EC3563.5	1	2	3	-	3	-	-	-	2	-	-	2	2	-
EC3563.6	1	2	3	2	3	-	-	-	2	-	-	2	2	2
AVG	2	2	3	2	3	-	-	-	2	-	-	2	2	2

1 - Low, 2 - Medium, 3 - High, '-' - No correlation

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. Ecosystem 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 (OHSMS). Environmental protection, Environmental protection acts, Environmental policies and various Environmental Programmes conducted around the world.

UNIT- III RENEWABLE SOURCES OF ENERGY 6

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, 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 \(s3waas.gov.in\)](https://redbook26-5-2017.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
EC3564.1	3	3	3	-	3	-	-	-	3	-	-	3	2	2
EC3564.2	3	3	3	-	3	-	-	-	3	-	-	2	2	-
EC3564.3	3	3	2	-	3	-	-	-	3	-	-	2	2	-
EC3564.4	3	3	2	-	3	-	-	-	3	-	-	2	2	-
EC3564.5	3	3	3	-	3	-	-	-	3	-	-	2	2	-
EC3564.6	3	2	3	3	-	1	-	-	3	-	-	3	2	2
AVG	3	3	3	3	3	1	-	-	3	-	-	2	2	2

Requirements for a batch of 30 students

Sl. No.	Description of Equipment	Quantity required (R)
1	Keil μ vision5 IDE	10
2	Raspberry Pi Pico Development Board	2
3	Micro USB Cable	4
4	IR Sensor Module	2
5	HC-SR04 Ultrasonic sensor	2
6	Blynk Platform	10
7	LED	8
8	DHT11 Temperature Sensor	4
9	Arduino Uno.	4
10	Breadboard.	4
11	Resistor 220 ohm	20
12	Raspberry Pi 3 setup with monitor and USB Mouse & Keyboard	2
13	Resistor pack	1
14	Multimeter	2
15	Jumper wires	As required
16	Solderless breadboard	4
17	Type C USB Cable	4

OBJECTIVES:

- To learn Hardware Descriptive Language (Verilog/VHDL).
- To enable the students to efficiently analyze and design VLSI circuits in digital domain
- To apply the fundamental principles and design of VLSI circuit in analog domain
- To design Digital System using HDL and implement on FPGA
- To explore the integration of VLSI circuits with EDA platforms
- To analyze the result of logic and timing simulations and to use these simulation results to debug digital system.

LIST OF EXPERIMENTS:**Simulation using HDL and implementation in FPGA**

1. Design an Adder and Multiplier (Minimum 8 Bit).
2. Design of basic combinational circuits.
3. Design of basic sequential circuits.
4. Design an Universal Shift Register.
5. Design of Memories.
6. Design Finite State Machine (Moore and Mealy).
7. Design 3-bit synchronous up/down counter.
8. Design 4-bit Asynchronous up/down counter.

Simulation using circuit simulators

9. Design CMOS Basic Gates & Flip-Flops. Generate Manual/Automatic Layout.
10. Design a 4-bit synchronous counter using Flip-Flops. Generate Manual/Automatic Layout
11. Design a CMOS Inverter
12. Design a simple 5 transistor differential amplifier.

TOTAL: 45 Periods

COURSE OUTCOMES:

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

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

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3566.1	2	-	-	1	3	2	-	-	3	2	-	-	2	2
EC3566.2	3	3	1	2	3	2	-	-	3	2	1	1	2	2
EC3566.3	1	2	2	3	3	2	-	-	3	2	2	1	2	2
EC3566.4	-	1	3	3	3	2	-	-	3	2	3	1	2	3
EC3566.5	-	2	2	2	3	2	-	-	3	2	-	2	2	3
EC3566.6	3	3	3	3	3	2	2	2	3	2	2	2	2	2
AVG	2	2	2	2	3	2	2	2	3	2	2	1	2	2

1 - Low, 2 - Medium, 3 - High, '-' - No correlation

Requirements for a batch of 30 students

Sl. No.	Description of Equipment	Quantity required (R)
1.	Xilinx ISE/Altera Quartus/ equivalent EDA Tools	10 user licence
2.	Cadence/Synopsis/ Mentor Graphics/Tanner/equivalent EDA Tools	10 user licence
3.	Personal Computer	30 Nos
4	Xilinx /Altera/equivalent FPGA Boards	10 Nos

EC3567	ANALOG AND DIGITAL COMMUNICATION	L	T	P	C
	LABORATORY	0	0	3	1.5

OBJECTIVES:

- To study the AM & FM Modulation and Demodulation.
- To learn and realize the effects of sampling and TDM.
- To understand the pulse modulation techniques.
- To analyze Digital Modulation Schemes.
- To explore the detection techniques in digital communication.
- To implement channel coding and error control coding Schemes in the communication system.

LIST OF EXPERIMENTS

1. AM- Modulator and Demodulator
2. FM - Modulator and Demodulator
3. Signal sampling and TDM.
4. Pulse Code Modulation and Demodulation.
5. Pulse Modulation and Demodulation- PAM, PPM, PWM
6. Digital Modulation – ASK, PSK, FSK.
7. Delta Modulation and Demodulation.
8. Simulation of ASK, FSK, and BPSK Generation and Detection Schemes.
9. Simulation of QPSK and QAM Generation and Detection Schemes.
10. Simulation of Linear Block and Cyclic Error Control coding Schemes.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design AM, FM & Digital Modulators for specific applications.
- Acquire knowledge in sampling, time division multiplexing and pulse modulation techniques.

- Simulate & analyze the various functional modules of Communication system.
- Demonstrate their knowledge in base band signaling schemes through implementation of digital modulation schemes.
- Understand the significance of demodulation techniques in various digital communication schemes.
- Apply various channel coding & error control coding schemes to demonstrate their capabilities towards the improvement of the noise performance of Communication system.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3567.1	3	3	3	3	2	1	2	-	3	2	1	1	2	-
EC3567.2	3	3	3	3	2	1	2	-	3	2	1	1	3	-
EC3567.3	3	3	3	3	3	1	2	-	3	2	1	1	2	2
EC3567.4	3	3	3	3	3	1	2	-	3	2	1	1	3	3
EC3567.5	3	3	3	3	2	1	2	-	3	2	1	1	2	2
EC3567.6	3	3	3	3	2	1	2	-	3	2	1	1	3	2
AVG	3	3	3	3	2	1	2	-	3	2	1	1	3	2

LAB Requirements for a Batch of 30 students (3 students per experiment):

- i) Kits for Signal Sampling & TDM, AM, FM, PCM and PM.
- ii) CROs/DSOs – 15 Nos, Function Generators – 15 Nos.
- iii) MATLAB or equivalent software package for simulation experiments
- iv) PCs - 15 Nos

EC3661	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To study the fundamental concepts of cellular system design.
- To understand about mobile radio propagation models and fading methods.
- To learn about the concepts of diversity and equalization techniques.
- To familiarize with the different methods of multiple access techniques.
- To describe about MIMO communications.
- To explore about multiple user techniques used in the mobile communication.

UNIT-I: THE CELLULAR CONCEPT-SYSTEM DESIGN 9
FUNDAMENTALS

Introduction-Frequency Reuse-Channel Assignment Strategies-Handoff Strategies: Prioritizing Handoffs, Practical Handoff Considerations. Interference and System Capacity: Co-Channel Interference and System Capacity-Channel Planning For Wireless Systems, Adjacent Channel Interference, Improving Coverage and Capacity In Cellular Systems: Cell Splitting, Sectoring.

UNIT-II: MOBILE RADIO PROPAGATION 9

Large Scale Path Loss: Introduction To Radio Wave Propagation - Free Space Propagation Model – Three Basic Propagation Mechanism: Reflection – Brewster Angle- Diffraction – Scattering. Small Scale Fading and Multipath: Small Scale Multipath Propagation, Factors Influencing Small-Scale Fading, Doppler Shift, Coherence Bandwidth, Doppler Spread And Coherence Time. Types Of Small-Scale Fading: Fading Effects Due To Multipath Time Delay Spread, Fading Effects Due To Doppler Spread.

UNIT-III: EQUALIZATION AND DIVERSITY TECHNIQUES 9

Equalization, Diversity and Channel Coding: Introduction-Fundamentals Of Equalization- Linear and Non Linear Equalizers, Adaptive Equalization -Diversity Techniques: Micro and Macro Diversity.

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)- Orthogonal Multiple Access (OMA).

UNIT-V: MIMO COMMUNICATIONS 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
- Assess the concepts in MIMO Communications

TEXT BOOKS:

1. Andreas.F. Molisch, "Wireless Communications", John Wiley – India, 2011.
2. Andrea Goldsmith, "Wireless Communication", Cambridge University Press, 2020.
3. Rappaport, T.S., "Wireless Communications", Pearson Education, Second Edition, 2010.

REFERENCES:

1. David.T and Pramod Viswanath, "Fundamentals of wireless communications", Cambridge University Press, First Edition, 2012
2. William Stallings, "Wireless Communication and Networks" Pearson Education, Second Edition 2005.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3661.1	3	2	3	2	3	-	-	-	-	-	-	2	3	2
EC3661.2	2	3	3	2	3	-	-	-	-	-	-	2	3	3
EC3661.3	3	3	2	2	3	-	-	-	-	-	-	2	2	3
EC3661.4	3	3	3	3	2	-	-	-	-	-	-	2	2	3
EC3661.5	3	3	3	3	3	-	-	-	-	-	-	2	2	2
EC3661.6	3	3	3	2	3	-	-	-	-	-	-	2	2	2
Avg	3	3	3	2	3	-	-	-	-	-	-	2	2	2

EC3662	COMPUTER NETWORKS AND SECURITY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the Network Models and its responsibilities.
- To learn the data link layer functions.
- To define the concept of routing in the Network Layer.
- To study the methods of communication and congestion control by the Transport Layer.
- To explore the Network Security Mechanisms.
- To analyze Hardware security attacks and their countermeasures.

UNIT-I: NETWORK MODELS AND DATALINK LAYER 9

Overview of Networks and its Attributes – Network Models – OSI, TCP/IP, Addressing –Introduction to Datalink Layer – Error Detection and Correction – Ethernet(802.3)- Wireless LAN – IEEE 802.11,Bluetooth – Flow and Error Control Protocols – HDLC – PPP.

UNIT-II: NETWORK LAYER PROTOCOLS 9

Network Layer – IPv4 Addressing – Network Layer Protocols (IP, ICMP and Mobile IP) Unicast and Multicast Routing – Intra-domain and Inter-domain Routing Protocols – IPv6 Addresses –IPv6 –Datagram Format - Transition from IPv4 to IPv6.

UNIT-III: TRANSPORT AND APPLICATION LAYERS 9

Transport Layer Protocols – UDP and TCP Connection and State Transition Diagram –Congestion Control and Avoidance (DEC bit, RED) - QoS - Application Layer Paradigms –Client – Server Programming – Domain Name System – World Wide Web, HTTP, Electronic Mail.

UNIT-IV: NETWORK SECURITY 9

OSI Security Architecture – Types of Attacks – Security Services and Mechanisms – Encryption – Advanced Encryption Standard – Public Key Cryptosystems – RSA Algorithm – Hash Functions – Secure Hash Algorithm – Digital Signature Algorithm.

UNIT-V: **HARDWARE SECURITY**

9

Introduction to Hardware security, Hardware Trojans, Side Channel Attacks – Physical Attacks and Countermeasures – Design for Security. Introduction to Blockchain Technology.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the Network Models and its behavior.
- Describe the Network layers and its functions
- Study the classification the routing protocols.
- List the functions of the transport layer.
- Elaborate the functions of Application layer.
- Evaluate and choose the network security mechanisms.

TEXT BOOKS:

1. Behrouz.A.Forouzan, Data Communication and Networking, Fifth Edition, TMH,2017.(Unit – I,II,III)
2. William Stallings, Cryptography and Network Security, Seventh Edition, Pearson Education, 2017(Unit- IV)
3. Bhunia Swarup, Hardware Security –A Hands On Approach, Morgan Kaufmann, First edition, 2018.(Unit – V).

REFERENCES:

1. James.F.Kurose and Keith.W.Ross, Computer Networking – A Top – DownApproach, Sixth Edition, Pearson, 2017.

2. Douglas .E.Comer, Computer Networks and Internets with Internet Applications, Fourth Edition, Pearson Education, 2008.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3662.1	3	2	2	-	-	-	-	-	-	-	-	3	2	2
EC3662.2	2	2	3	-	-	-	-	-	-	-	-	2	2	-
EC3662.3	2	2	3	-	-	-	-	-	-	-	-	2	2	-
EC3662.4	1	2	3	-	-	-	-	-	-	-	-	2	2	-
EC3662.5	1	2	3	-	-	-	-	-	-	-	-	2	2	-
EC3662.6	1	2	3	2	-	-	-	-	-	-	-	2	2	2
AVG	2	2	3	2	-	-	-	-	-	-	-	2	2	2

EC3663	ANTENNAS AND WAVE PROPAGATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To provide a comprehensive understanding of the fundamental parameters that characterize antenna.
- To learn the basic principles of thin linear wire antennas including their radiation mechanisms and practical design considerations.
- To analyze the principles and applications of antenna arrays.
- To understand the radiation characteristics and design of various aperture and slot antennas.
- To explore the characteristics and applications of special antennas.
- To familiarize the different modes of radio wave propagation.

UNIT-I: ANTENNA BASICS AND LINEAR WIRE ANTENNAS 9

Definition of antenna parameters – Radiation Resistance, Antenna Polarization, Radiation Patterns, Beam Width, Radiation Intensity, Beam Area, Directivity, Gain, Antenna Aperture, Effective length, Bandwidth, Antenna Temperature, Reciprocity in Antennas, Friis Transmission Formula, Radiation from oscillating dipole, Half wave dipole, Quarter Wave Monopole.

UNIT-II: ANTENNA ARRAYS 9

N element linear array, Pattern multiplication, Broadside and End fire array, Concept of Phased arrays, Adaptive array, Basic principle of antenna Synthesis-Binomial array, Tchebyshev distribution.

UNIT-III: APERTURE ANTENNAS 9

Radiation from Rectangular, Uniform and Tapered aperture, Horn antennas, Slot antenna, Reflector antennas- Aperture blockage, Feeding structures, Applications of aperture antennas.

UNIT-IV: SPECIAL ANTENNAS AND ANTENNA MEASUREMENTS 9

Yagi-Uda Antenna, Travelling Wave Antenna, Rhombic Antenna, Small Loop Antenna, Helical Antenna, Log-Periodic Antenna, Microstrip Patch Antenna. Antenna Measurements- VSWR, Impedance, Gain and Radiation pattern.

UNIT-V: PROPAGATION OF RADIO WAVES 9

Modes of propagation, Structure of atmosphere, Ground wave propagation, Tropospheric propagation, Duct propagation, Troposcatter propagation, Flat earth and Curved earth concept, Sky wave propagation – Virtual height, critical frequency, Maximum usable frequency – Skip distance, Fading.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the fundamentals of antenna and its parameters.
- Apply the principle of pattern multiplication to predict and analyze the radiation patterns of antenna arrays.
- Analyze the methods to find the field components of different aperture antennas.
- Design the special antennas for real time applications.
- Measure the antenna parameters.
- Describe the various modes of radio wave propagation.

TEXT BOOKS:

1. Antennas and Wave Propagation - J.D. Kraus, R.J. Marhefka and Ahmad S. Khan. TMH, New Delhi, 4th ed., (Special Indian Edition), 2010.
2. Antenna Theory- Analysis and Design- C.A. Balanis, John Wiley & Sons, 3rd ed., 2005.

- Electromagnetic Waves and Radiating Systems - E.C. Jordan and K.G. Balmain. PHI, 2nd ed.,2000.

REFERENCES:

- Antenna Theory and Design - Warren L. Stutzman, Gary A. Thiele, John Wiley & Sons, 3rd edition. 2013.
- Antenna and Wave Propagation – Harish AR and Sachidananda M, Oxford University Press,2007.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3663.1	3	3	3	3	-	-	-	-	-	-	-	2	3	2
EC3663.2	3	2	2	2	-	-	-	-	-	-	-	2	3	2
EC3663.3	3	3	2	2	-	-	-	-	-	-	-	2	3	2
EC3663.4	3	3	2	3	-	-	-	-	-	-	-	2	3	2
EC3663.5	3	2	3	2	-	-	-	-	-	-	-	2	3	2
EC3663.6	3	3	2	3	-	-	-	-	-	-	-	2	3	2
AVG	3	3	2	3	-	-	-	-	-	-	-	2	3	2

EC3664	WIRELESS COMMUNICATION AND NETWORKING LABORATORY	L	T	P	C
		0	0	3	1.5
OBJECTIVES:					
<ul style="list-style-type: none"> To understand the Wireless channel characteristics 					
<ul style="list-style-type: none"> To analyze the equalization techniques applied to the wireless channels. 					
<ul style="list-style-type: none"> To explore the multicarrier modulation and multiple access techniques used in wireless communication. 					
<ul style="list-style-type: none"> To acquire knowledge on the features of the network layers. 					
<ul style="list-style-type: none"> To implement the protocols in the different layers of network. 					
<ul style="list-style-type: none"> To estimate the performance and QoS of wireless networks. 					
LIST OF EXPERIMENTS					
<ol style="list-style-type: none"> 1. Characterization of Wireless Channels. 2. Simulation of Equalization Techniques for Wireless Channels. 3. Simulation / Implementation of Multicarrier Modulation. 4. Implementation of Space Time Block Codes. 5. Simulation of Adaptive Modulation and Coding. 6. Modelling and simulation of TDMA, FDMA and CDMA for wireless Communication. 7. Simulation of Ethernet Wired LAN (IEEE 802.3). 8. Implementation of Error Detection / Error Correction Techniques. 9. Study the performance of network with CSMA / CA protocol. 10. Implementation of Flow control Algorithms. 11. Simulation and performance evaluation of a network using TCP and UDP. 12. QoS Analysis of Wireless Networks. 					
TOTAL : 45 Periods					
COURSE OUTCOMES:					
On completion of the course, the student will be able to					
<ul style="list-style-type: none"> Interpret the significance of the protocols used in the network. 					

- Illustrate the characteristics of network layers.
- Discriminate the multicarrier modulation and the multiple access methods.
- Apply the equalization techniques to the wireless channel.
- Characterize the behavior of the wireless channels in different scenarios.
- Assess the QoS of wireless networks.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3664.1	2	2	-	-	3	-	-	-	2	2	-	2	-	3
EC3664.2	2	-	-	-	3	-	2	-	2	2	-	2	2	3
EC3664.3	2	-	-	-	3	-	-	-	2	2	-	2	2	3
EC3664.4	2	2	3	2	3	-	2	-	2	2	-	2	2	3
EC3664.5	3	-	-	-	3	2	-	-	2	2	-	2	2	3
EC3664.6	2	2	-	2	3	2	2	-	2	2	2	2	2	3
AVG	2	2	3	2	3	2	2	-	2	2	2	2	2	3

LAB REQUIREMENTS FOR A BATCH OF 30 STUDENTS

S.No	Equipment / Software	Required
1	Desktop Computer	30 Nos.
2	MATLAB	15 Users
3	Network Simulator NS3/Glomosim/OPNET/ Packet Tracer	30 Users

EC3645

MINI PROJECT

L	T	P	C
0	0	4	2

OBJECTIVES:

- To identify and define problems in the field of specialization.
- To develop and implement methodologies to find the solution.
- To conduct experiments and analyze results.
- To prepare comprehensive project reports.
- To enhance presentation skills.
- To collaborate and work independently.

The students shall individually / or as group work on a specific topic approved by the Department. The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

TOTAL : 60 Periods

COURSE OUTCOMES:

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

- Formulate and analyze complex problems or innovate new products/processes, applying theoretical knowledge to practical scenarios.

- Show competence in designing and executing experiments to investigate solutions to the identified problem, utilizing appropriate tools and methodologies.
- Analyze experimental data, providing insightful solutions to the problem, and compile these findings into a coherent project report with clear conclusions and recommendations.
- Produce comprehensive project reports that accurately document the research process, findings, and implications, following the prescribed academic format and standards.
- Deliver clear and engaging presentations that effectively communicate the project's objectives, methods, results, and conclusions to a diverse audience.
- Exhibit strong collaboration and independent work skills, managing project responsibilities efficiently whether working in a team or individually.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3645.1	3	3	3	3	2	2	2	-	2	1	2	2	3	2
EC3645.2	3	3	3	3	2	2	2	-	1	1	2	2	3	2
EC3645.3	3	3	3	3	3	-	-	-	2	2	2	2	3	3
EC3645.4	3	3	3	3	2	-	-	2	1	3	2	2	3	2
EC3645.5	3	3	3	3	2	-	-	-	2	3	2	2	2	2
EC3645.6	3	3	3	3	2	-	-	2	3	3	3	2	2	2
AVG	3	3	3	3	3	2	2	2	2	2	2	2	3	2

OBJECTIVES

The course aim to

- enhance the Employability and Career Skills of students.
- orient the students towards grooming as a professional.
- 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:

- make effective presentations and participate confidently in Group Discussions
- attend job interviews and interacting in different situations.
- able to write business reports, proposals and related correspondence.
- develop adequate Soft Skills required for the workplace

REFERENCE BOOKS:

1. Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015
2. Interact English Lab Manual for Undergraduate Students, Orient Blackswan: Hyderabad, 2016.
3. E.Suresh Kumar Communication for Professional Success. Orient Blackswan: Hyderabad, 2015
4. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University Press: Oxford, 2014
5. S. Hariharan. Soft Skills. MJP Publishers: Chennai, 2010.
6. Successful Presentations: DVD and Student's Book. A video series teaching business communication skills for adult professionals by John Huges and Andrew Mallett- OUP 2012.
7. Goodheart-Willcox, "Professional Communication", First Edition, 2017. Online test book
8. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 Edition, 2015
9. English for success in Competitive exams. Philip Sunil Solomon – OUP 2009.

Course Outcomes	PROGRAM OUTCOMES												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	-	-	-	-

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

OBJECTIVES:

- To learn the microwave frequency bands, their applications and limitations of microwave devices.
- To understand the basic principles and their structures of microwave power generation devices.
- To apply the scattering matrix and illustrate the microwave measurements of microwave devices.
- To analyze the optical fibers and their utility in communication.
- To familiarize the fundamentals and propagation modes of optical fibers.
- To explore the sources and detectors used for optical communication.

UNIT-I: MICROWAVE NETWORK AND CIRCUIT REPRESENTATION 9

Microwave frequency bands, S parameter representation of N ports, Properties, Advantages, Directional coupler, Waveguide Tees, Isolator, Circulator, Slotted section, Waveguide Bends, Matched loads, Attenuator.

UNIT-II: MICROWAVE DEVICES 9

RWH theory, Gunn effect, Gunn diode, Avalanche transit time devices, PIN diode, TRAPATT diode, IMPATT diode, Principle, characteristics of TWT, Klystron, Reflex klystron, Magnetron, Applications of microwave devices.

UNIT-III: MICROSTRIP LINES AND MICROWAVE MEASUREMENTS 9

Microstrip lines, Losses in Microstrip lines, Quality factor of Microstrip lines, Microstrip line low pass and high pass filters, Measurements: S parameters, Impedance, Frequency, Wavelength, Power, VSWR, Attenuation.

UNIT-IV: OPTICAL FIBER STRUCTURES AND DIGITAL TRANSMISSION SYSTEMS 9

Elements of an optical fiber transmission link, Total internal reflection, Acceptance angle, Numerical aperture, Single mode fibers, Graded index fiber structure, Indoor and outdoor fiber cables, Fiber fabrication techniques, Linearly polarized modes.

UNIT-V: OPTICAL SOURCES AND RECEIVERS**9**

Direct and indirect band gap materials, LED structures: SLED, ELED, Concept of LASER diode, Operation of PIN diodes and Avalanche Photo diodes (APD), Probability of error and Error sources in optical systems, Point to point link system considerations, Link power budget and rise time budget.

TOTAL : 45 Periods**COURSE OUTCOMES:**

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

- Understand the microwave frequency bands
- Explore the mechanism of microwave devices.
- Demonstrate the conceptual and operational characteristics of different microwave Tube circuits.
- Analyze the high frequency components using Scattering matrix.
- Assess the mechanism of light propagation through optical fibers.
- Classify optical sources and detectors and analyze various coupling losses.

TEXT BOOKS:

1. Samuel Y. Liao, "Microwave Devices & Circuits", 4th Edition, Pearson Education, New Delhi, 2023.
2. Gerd Keiser, "Optical Fiber Communication", 6th Edition, McGraw Hill, New Delhi, 2022.

REFERENCES:

1. Annapurna Das & Sisir K. Das, "Microwave Engineering", 4th Edition, McGraw Hill Inc, New Delhi, 2020.
2. David M. Pozar, "Microwave Engineering", 5th Edition, John Wiley & Sons, 2023.
3. John M. Senior, "Optical Fiber Communication", 4th Edition, Pearson Education, New Delhi, 2022.
4. George Kennedy, "Electronic Communication System", McGraw Hill, 6th Edition, 2013.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3761.1	3	3	3	3	-	-	-	-	-	-	-	2	3	3
EC3761.2	3	3	3	3	-	-	-	-	-	-	-	2	3	3
EC3761.3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
EC3761.4	3	3	3	3	-	-	-	-	-	-	-	2	3	3
EC3761.5	3	3	3	3	-	-	-	-	-	-	-	2	3	3
EC3761.6	3	3	3	3	-	-	-	-	-	-	-	2	3	3
AVG	3	3	2	3	-	-	-	-	-	-	-	2	3	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
C01							1	
C02			1					
C03							1	
C04				1				
C05				2				
			1	2			1	

EC3763	ARTIFICIAL INTELLIGENCE AND MACHINE	L	T	P	C
	LEARNING TECHNIQUES				
		3	0	2	4

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 neural networks and graphical models
- Explore the applications based on AI & ML

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 AND 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

COURSE OUTCOMES:

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

- Understand AI concepts, applications, and problem-solving using search strategies
- Apply uninformed, heuristic, local, and adversarial search methods.
- Use probabilistic models like Bayesian networks for reasoning under uncertainty.
- Implement supervised learning techniques including regression and classification.
- Apply ensemble learning and unsupervised methods such as K-means and GMM.
- Explore evolutionary algorithms, reinforcement learning, and graphical models and applications.

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
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
EC3763.1	3	2	2	1	1	-	-	-	-	-	-	-	3	2
EC3763.2	3	3	3	2	1	-	-	-	-	-	-	-	3	2
EC3763.3	3	3	2	2	2	-	-	-	-	-	-	-	3	3
EC3763.4	3	3	3	2	2	-	-	-	-	-	-	-	3	3
EC3763.5	3	2	2	2	2	-	-	-	-	-	-	-	3	3
EC3763.6	3	3	3	3	2	-	-	-	-	-	-	-	3	3
AVG	3	3	2	2	2	-	-	-	-	-	-	-	3	2

OBJECTIVES:

- To study the microwave passive & active devices, tubes and network analysis.
- To acquire the insights of microwave transmission using microwave bench setup.
- To apply the scattering matrix for the analysis of different microwave passive components.
- To understand the characteristics and measurements in optical fiber.
- To realize the working principle of optical source, detector and fibers.
- To explore the building blocks of fiber optic communication link.

MICROWAVE EXPERIMENTS

1. Gunn diode characteristics
2. Reflex Klystron mode characteristics
3. Microwave parameters measurement using test bench - VSWR, Frequency, Wavelength, Attenuation.
4. S-parameter Measurement of microwave components- Isolator, Circulator and Magic Tee.
5. Characterization of Directional Coupler.
6. Radiation Pattern measurement of Horn Antenna / Parabolic Reflector Antenna.
7. Microwave measurements using a Vector Network Analyzer
 - a. Return loss
 - b. VSWR
 - c. Impedance

OPTICAL WAVE EXPERIMENTS

1. Numerical Aperture determination for Fiber.
2. Measurement of attenuation, bending and connector loss.
3. Mode Characteristics of Fiber.
4. DC Characteristics of LED and PIN Photo diode.
5. Fiber optic Analog and Digital Link- frequency response (analog) and eye diagram (Digital)

TOTAL PERIODS: 45

COURSE OUTCOMES:

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

- Understand the characteristics of microwave devices.
- Demonstrate the microwave bench setup and acquire knowledge of microwave transmission.
- Assess the performance of the microwave networks using the scattering matrix.
- Examine the mode characteristics of fiber.
- Evaluate the characteristics of optical source and detector.
- Analyze the performance of fiber optic communication link.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3764.1	3	1	3	2	1	-	-	-	3	2	-	2	2	2
EC3764.2	3	2	2	2	1	-	-	-	3	2	-	2	-	2
EC3764.3	3	2	3	2	1	-	-	-	3	2	-	2	2	2
EC3764.4	3	2	2	2	1	-	-	-	3	2	-	2	2	2
EC3764.5	3	2	1	1	1	-	-	-	3	2	-	2	-	2
EC3764.6	3	3	2	1	1	-	-	-	3	2	-	2	-	2
AVG	3	2	2	2	1	-	-	-	3	2	-	2	2	2

OBJECTIVES:

- Get connected with industry/laboratory/research institute
- Get practical knowledge on production process in the industry and develop skills to solve related problems
- Develop skills to carry out research in the research institutes/laboratories

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.

No. of Weeks: 02

COURSE OUTCOMES:

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

- System-level design processes, verification and validation techniques, manufacturing and production processes in the firm or research facilities in the laboratory/research institute
- Analysis of industrial / research problems and their solutions
- Documentation of system specifications, design methodologies, process parameters, testing parameters and results
- Preparing of technical report and presentation

OBJECTIVES:

- To able to consolidate the literature search and formulate the problem for the project Work.
- To devise a solution for the problem identification.
- To design the project to meet specifications using the modern tools.
- To construct and develop the project adhering to the norms and Professional ethics
- To conduct the validation, analyze and discuss the test results, make conclusions and contribute to the society as an individual or as a team.
- To prepare the project reports and presentation.

The students shall individually / or as group work on a specific topic approved by the Department. The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the regulations.

TOTAL : 300 Periods

COURSE OUTCOMES:

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

- Formulate and analyze problem / create a new product/ process.
- Identify the appropriate modern tools for the problem identified.
- Plan and manage the time effectively as an individual or as a team.
- Design and evaluate to find solution.

- Explore the knowledge for the real world situations that a professional engineer can encounter.
- Orally present and demonstrate their product to peers, academics, general and industry community.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
EC3841.1	3	3	3	3	2	3	3	-	3	2	3	3	3	3
EC3841.2	3	3	3	3	3	3	3	2	3	2	3	3	3	3
EC3841.3	3	3	3	3	2	2	-	-	2	3	3	3	3	3
EC3841.4	3	3	3	3	3	2	2	2	3	2	3	3	3	3
EC3841.5	2	2	3	3	3	2	-	-	2	3	3	3	2	3
EC3841.6	2	1	1	3	2	2	1	1	1	2	2	1	1	1
AVG	3	3	3	3	3	3	2	2	2	2	3	3	3	3

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			

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 Implementation, Routledge; 1st edition, 2019
3. 3.Poornima M. Charantimath, Total Quality Management, Pearson Education, 2 nd Edition,2017.
4. Dale H. Besterfield, Carol Besterfield, Michna, Glen H. Besterfield, Mary Besterfield, Sacre, Hermant, Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised 4 th Edition, Pearson Education, 2013.
5. Shridhara Bhat K, Total Quality Management – Text and Cases, Himalaya Publishing House, 2 nd Edition 2010.
6. Douglas C. Montgomery, Introduction to Statistical Quality Control, Wiley Student Edition, 7 th Edition, Wiley India Pvt Limited, 2012.
7. Indian Standards – Quality management systems – Guidelines for performance 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				

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 and Grievance 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 and grievance 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				

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: ENTREPRENEURIAL MOTIVATION 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				

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, 20th 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, 6th edition, 2014
2. Rege, Sharmila (ed), Sociology of Gender: The Challenge of Feminist Sociological Knowledge, Sage, New Delhi, 2003.
4. Bonnie G. Smith, 2013 Women’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	

OBJECTIVE

- To make the students aware of the finer sensibilities of human existence through an art form
- To enable students to appreciate different forms of literature
- To help students understand that literature is an expression of life's experience.
- To improve the aesthetic sense of the students by exposing them to various forms of literature
- 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 Play**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

1. Seasons of Life: A Poetic Anthology (Literary Classics) by Nigel Collins, Jim Herrick, John Pearce (ISBN: 9781573927710)
2. Web Link :<https://www.amazon.co.uk/Seasons-Life-Anthology-Literary-Classics/dp/1573927716>
3. 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)
4. Web Link : <https://www.amazon.in/New-One-Act-Plays-Acting-Students/dp/1566080843>
5. 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>
6. Famous Novels and Short stories in English.(to be recommended by teachers to individual students)
7. Collection of poems by Robert Frost, William Wordsworth, Rabindranath Tagore, Walt Whitman , Maya Angelou, Rudyard Kipling (to be recommended by teachers to individual students)

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 Regime 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 secret law, determination of trade secret status, liability for misappropriations of trade secrets, protection for submission, trade secret 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 Countries, Oxford University Press
2. R. Anita Rao & Bhanoji Rao, Intellectual Property Rights- A Primer, Eastern Book Co.
3. Shiv Sahai Singh, The Law Of Intellectual Property Rights, Eastern Book Co.
4. Deepa Goeland Shomini Parashar, IPR, Biosafety and Bioethics, Pearson publisher
5. Pandey, Neeraj, Dharni, Khushdeep, Intellectual Property Rights, PHI, 2020.
6. Sople, Vinod V. Managing Intellectual Property: The Strategic Imperative, PHI, 2020.

OBJECTIVES:

- To understand the core concepts, history, and significance of Industrial Psychology
- To analyze factors influencing employee attitudes, behaviors, and well-being.
- To apply principles of ergonomics and human factors to improve workplace design and safety.
- To evaluate different theories of motivation and their practical applications in organizational settings.
- 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.

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
AVG	2	3	2	2	1	1	1	2

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 9

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 9

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 9

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 FUNCTIONOONS 9

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 9

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

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**4+2**

Health: Importance of maintaining health- prevention than treatment - Ten types of health - Physical - Mental - Social – Financial - Emotional - Spiritual - Intellectual - Relationship – Environmental and 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**6+4**

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

4+4

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 (Tri-Dosha 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

3+4

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

2+12

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, 2016.
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.
3. Yoga and Empowerment, WCSC-VISION for Wisdom, 3rd Edition 2018, Vethathiri Publications, Erode
4. SIDDHA MEDICINE HANDBOOK OF TRADITIONAL REMEDIES Kindle Edition by Paul Joseph Thottam (Author) 2012.
5. The Ayurvedic Pharmacopoeia of India Part-I Volume-VII First Edition [Minerals & Metals] by Central Council for Research in Ayurveda and Siddha, 2008

REFERENCES:

1. WHAT WE KNOW ABOUT EMOTIONAL INTELLIGENCE
How It Affects Learning, Work, Relationships, and Our Mental Health, by Moshe Zeidner, Gerald Matthews, and Richard D. Roberts A Bradford Book, The MIT Press, Cambridge, Massachusetts, London, England 2009
2. .The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001. 2018
3. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/>
4. Simple lifestyle modifications to maintain health
<https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habitsbetterhealth#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.>
5. Read more: <https://www.legit.ng/1163909-classes-food-examples-functions.html>
6. <https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926>
7. Benefits of healthy eating <https://www.cdc.gov/nutrition/resources-publications/benefitsof-healthy-eating.html>
8. Food additives
<https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/foodadditives>
9. BMI <https://www.hsph.harvard.edu/nutritionsource/healthy-weight/>
<https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle--who-recommendations>
10. Yoga <https://www.healthifyme.com/blog/types-of-yoga/>
<https://yogamedicine.com/guide-types-yoga-styles/>
11. Ayurveda : <https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda>
12. Siddha : http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp

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 makhtabs, 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.

REFERENCES:

1. Ramasamy, K.A., and Seshagiri Rao, K., (Eds), Science, Technology and education for Development, 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:

- The origins of scientific knowledge, Names, major milestones in the life and work of prominent scientists and engineers.
- Periodization of the history of science and technology.
- Major events, dates of the most significant achievements in the development of science and technology at different stages of history;
- 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.
- Features of science and technology and its development

- ASSESSMENT:

Quizzes

Assignment,

Case Study / Presentation

Continuous Assessment Test

- **CO3** - Determine evidentiary reporting in forensic acquisition.
- **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. Richard S. Grimes, "Cyber Law and Cyber Security: Legal and Ethical Issues," CRC Press, 1st Edition, 2019.
2. Sunit Belapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, WileyIndia Pvt. Ltd, 2011.
3. Jonathan Rosenoer, "Cyber Law: The law of the Internet", Springer–Verla..

Reference Books

1. Pavan Duggal, "Cyber Security and Cyber Laws," LexisNexis, 4th Edition, 2020.
2. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", Cambridge University Press, 2006.
3. Dr. Farooq Ahmad, Cyber Law in India, Allahbad Law Agency– Faridabad.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)											
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
1	2											2
2		2		2		2						
3								2				
4		3	2					2				2
5	2					2						
av g	2	2.5	2	2		2		2				2

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.

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	

PEC101	WIDE BANDGAP DEVICES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamental principles and characteristics of wide bandgap (WBG) devices.
- To identify the key factors that affect the switching behavior of WBG devices.
- To enhance material quality and reduce defects to enable high-power, high-frequency operation.
- To ensure efficient and reliable switching of wide bandgap power devices
- To understand the concepts of high-frequency design complexity and PCB design.
- To achieve high energy transfer efficiency to minimize power loss of WBG devices.

UNIT-I: WBG DEVICES AND THEIR APPLICATION IN REAL WORLD 9

Review of semiconductor basics - Operation and characteristics of the SiC Schottky Barrier Diode- SiC DMOSFET and GaN HEMT- Review of Wide bandgap semiconductor technology -Advantages and disadvantages

UNIT-II: SWITCHING CHARACTERIZATION OF WBG 9

Turn-on and Turn-off characteristics of the device- Hard switching loss analysis- Double pulse test set-up.

UNIT-III: DRIVERS FOR WIDE BAND GAP DEVICES 9

Gate driver- Impact of gate resistance- Gate drivers for wide bandgap power devices - Transient immunity integrated gate drivers

UNIT-IV: HIGH FREQUENCY DESIGN COMPLEXITY AND PCB DESIGNING 9

Effects of parasitic inductance - Effects of parasitic capacitance - EMI filter design for high frequency power converters -High frequency PCB design - Conventional power loop design - High frequency power loop optimization - Separation of power from signal PCB.

UNIT-V: APPLICATIONS OF WIDE BANDGAP DEVICES 9

Consumer electronics applications - Wireless power transfer applications - Electric vehicle applications - Renewable energy sources applications

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understanding of WBG devices, including their materials, structures, and properties.
- Design and optimize switching circuits using WBG devices.
- Analyze the system efficiency and power density due to fast switching times and low switching losses.
- Design and routing RF PCBs for to meet performance and reliability requirements.
- Design and optimize Wide Bandgap (WBG) devices to achieve high energy transfer efficiency, minimizing power loss and extending battery life in various applications
- Analyze the applications of WBG with respect to the renewable energy sources.

TEXT BOOKS:

1. A. Lidow, J. Strydom, M. D. Rooij, D. Reusch, GaN Transistors for Efficient Power Conversion, Wiley, 2014, ISBN-13: 978-1118844762.
2. G. Meneghesso, M. Meneghini, E. Zanoni, "Gallium Nitride-enabled High Frequency and High Efficiency Power Conversion," Springer International Publishing, 2018, ISBN: 978-3- 319-77993-5

REFERENCES:

1. F. Wang, Z. Zhang and E. A. Jones, Characterization of Wide Bandgap Power Semiconductor Devices, IET, ISBN-13: 978-1785614910 (2018).
2. B.J.Baliga, "Gallium Nitride and Silicon Carbide Power Devices," World Scientific Publishing Company (3 Feb. 2017).
3. L. Corradini, D. Maksimovic, P. Mattavelli, R. Zane, "Digital Control of High Frequency Switched-Mode Power Converters", Wiley, ISBN-13: 978-1118935101 (9th June, 2015).

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC101.1	3	3	3	2	-	-	-	-	-	-	-	-	3	3
PEC101.2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC101.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC101.4	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC101.5	3	3	3	2	-	-	-	-	-	-	-	-	3	3
PEC101.6	3	3	3	3	-	-	-	-	-	-	-	-	3	3
AVG	3	3	3	3	-	-	-	-	-	-	-	-	3	3

PEC102	VALIDATION AND TESTING TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Getting familiar with various IC technology.
- Learn MOS theory and testing
- Learn CMOS circuit theory and testing
- Getting expertise on CMOS characterization.
- Explore circuit and device level testing methods
- To understand the basics of Testing and Fault Modeling

UNIT-I: TECHNOLOGY INTRODUCTION: 9

Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & BiCMOS Technologies. VLSI Fabrication, Oxidation, Lithography, Diffusion, Ion Implantation, Metallization, Integrated Resistors and Capacitors.

UNIT-II: MOS THEORY ANALYSIS-I 9

Basic Electrical Properties of MOS Circuits: I_{ds} - V_{ds} Relationships, MOS Transistor Threshold Voltage V_{th} , g_m , g_{ds} , Figure of Merit ω_0 , Short Channel and Narrow Channel Width Effects.

UNIT-III: MOS THEORY ANALYSIS- II 9

Pass Transistor, Transmission Gate, NMOS Inverter, Various Pull-ups, CMOS Inverter Analysis and Design, Bi-CMOS Inverters, Latch up in CMOS Circuits.

UNIT-IV: CMOS CIRCUIT CHARACTERISATION AND PERFORMANCE ESTIMATION 9

Sheet Resistance, conductivity and its Concept to MOS, Area Capacitance Units, Calculations -Delays, Driving Large Capacitive Loads, Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Reliability.

UNIT-V: BASICS OF SILICON VALIDATION**9**

Need for Testing, Testing at Various Levels, Objectives of Testing - VLSI Test process and Test Equipment - Types of Testing: Functionality Tests, Silicon Debug, Manufacturing Tests, Defect during manufacturing - Fault Modelling, Observability and Controllability, Fault Coverage, Fault Sampling - ATE, Test economics.

TOTAL : 45 Periods**COURSE OUTCOMES:**

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

- Complete overview to CMOS fabrication process.
- Understand the fundamental concept of MOS FET and testing.
- Estimate the power spectrum of random signals in the presence of noise
- Describe the concept of MOS theory and analysis.
- To give the student an understanding of CMOS performance testing and estimation.
- Understand the basics of Testing and Fault Modeling
- To give the student an understanding of CMOS performance testing and estimation

TEXT BOOKS:

1. Kamran Ehraghian, Douglas A. Pucknell and Sholeh Eshraghian, "Essentials of VLSI Circuits and Systems" – PHI, EEE, 2005 Edition.
2. Neil H. E. Weste and David. Harris Ayan Banerjee, "CMOS VLSI Design" - Pearson Education, 1999.

REFERENCES:

1. M.L. Bushnell and V.D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2004.
2. N.K. Jha and S.G. Gupta, "Testing of Digital Systems", Cambridge University Press, 2003.
3. Etienne Sicard, Sonia Delmas Bendhia, "Basics of CMOS Cell Design", TMH, EEE, 2005.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC102.1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC102.2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC102.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC102.4	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC102.5	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC102.6	3	3	3	3	-	-	-	-	-	-	-	-	3	3
AVG	3	3	3	3	-	-	-	-	-	-	-	-	3	3

Multipole Systems, Phase Margin, Frequency Compensation, Compensation Of Two Stage Op Amps, Slewing In Two Stage Op Amps, Other Compensation Techniques.

UNIT-V: LOGIC CIRCUIT TESTING

9

Faults in Logic Circuits- Basic Concepts of Fault Detection- Design for Testability- Ad Hoc Techniques, Level-Sensitive Scan Design, Partial Scan, Built-in Self-Test.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Create an amplifiers to meet user-defined specifications
- Examine the frequency and noise performance of an amplifier.
- Evaluate feedback amplifiers and single-stage operational amplifiers.
- Analyze the functional performance of two-stage operational amplifiers.
- Explain the operation of current mirrors and current sinks using MOSFETs.
- Identify and apply fault detection and testability techniques in analog circuits.

TEXT BOOKS:

1. Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Tata Mcgraw Hill, 2001. (Unit –I, II, III, IV)
2. Parag K.Lala, "An Introduction to Logic Circuit Testing", Morgan & Claypool Publishers, 2009. (Unit V)

REFERENCES:

1. Willey M.C. Sansen, "Analog Design Essentials", Springer, 2006.
2. Grebene, "Bipolar And Mos Analog Integrated Circuit Design", John Wiley & Sons, Inc., 2003.
3. Recorded Lecture Available at http://www.ee.iitm.ac.in/vlsi/courses/ee5320_2021/start.
4. Jacob Baker "CMOS: Circuit Design, Layout, And Simulation, Wiley IEEE Press, 3rd Edition, 2010.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC103.1	3	3	3	3	2	2	-	-	-	-	-	-	2	2
PEC103.2	3	3	2	2	2	1	-	-	-	-	-	-	2	2
PEC103.3	3	3	2	2	2	1	-	-	-	-	-	-	2	2
PEC103.4	3	3	3	2	2	2	-	-	-	-	-	-	2	2
PEC103.5	3	3	3	3	2	2	-	-	-	-	-	-	2	2
PEC103.6	3	3	3	3	3	2	-	-	-	-	-	-	2	2
AVG	3	3	3	3	2	2	-	-	-	-	-	-	2	2

OBJECTIVES:

- To understand Power Dissipation Sources.
- To analyze Low-Power Design Techniques.
- To design Low-Power Adders.
- To implement Low-Power Multipliers.
- To Evaluate Low-Power Memory Technologies.
- To recognize the requirements in Low-Power IC Design.

UNIT-I: FUNDAMENTALS OF LOW POWER CIRCUITS 9

Need for Low Power Circuit Design, Sources of Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Leakage Power Dissipation, Glitching Power Dissipation, Short Channel Effects – Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT-II: LOW-POWER DESIGN APPROACHES 9

Low-Power Design through Voltage Scaling: VTCMOS circuits, MTCMOS circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

UNIT-III: LOW-VOLTAGE LOW-POWER ADDERS 9

Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look-Ahead Adders, Carry Select Adders, Carry Save Adders, Low Voltage Low Power Design Techniques – Trends of Technology and Power Supply Voltage, Low Voltage Low-Power Logic Styles.

UNIT-IV: LOW-VOLTAGE LOW-POWER MULTIPLIERS 9

Introduction, Overview of Multiplication, Types of Multiplier Architectures, Braun Multiplier, BaughWooley Multiplier, Booth Multiplier, Introduction to Wallace Tree Multiplier

UNIT-V: LOW-VOLTAGE LOW-POWER MEMORIES**9**

Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Precharge and Equalization Circuit, Low Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

TOTAL : 45 Periods**COURSE OUTCOMES:**

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

- Describe the mechanisms of power dissipation in VLSI circuits and how they influence the need for low-power circuit design.
- Differentiate between low-power design techniques, such as voltage scaling and capacitance minimization, and apply the appropriate method for specific design challenges.
- Design low-power, low-voltage adder circuits utilizing CMOS architectures and advanced low-power logic styles.
- Develop optimized low-power multipliers using architectural approaches such as Braun, Baugh-Wooley, Booth, and Wallace Tree multipliers.
- Apply low-power design techniques to ROM, SRAM, and DRAM, focusing on innovative approaches to reduce power consumption while maintaining performance.
- Propose solutions and techniques in low-power IC design, incorporating cutting-edge technologies and methodologies to achieve significant power savings while maintaining or enhancing circuit performance.

TEXT BOOKS:

1. Sung-Mo Kang, Yusuf Leblebici, "CMOS Digital Integrated Circuits – Analysis and Design", TMH, 2011.
2. Kiat-Seng Yeo, Kaushik Roy, "Low-Voltage, Low-Power VLSI Subsystems", TMH Professional Engineering, 2004.

REFERENCES:

1. Ming-BO Lin, "Introduction to VLSI Systems: A Logic, Circuit and System Perspective", CRC Press, 2012.
2. Anantha Chandrakasan, "Low Power CMOS Design", IEEE Press, /Wiley International, 1998
3. Kaushik Roy, Sharat C. Prasad, "Low Power CMOS VLSI Circuit Design", John Wiley, & Sons, 2000.
4. Gary K. Yeap, "Practical Low Power Digital VLSI Design", Kluwer Academic Press, 2002
5. Bellamour, M. I. Elamasri, "Low Power CMOS VLSI Circuit Design", A Kluwer Academic Press, 1995.
6. Siva G. Narendran, Anatha Chandrakasan, "Leakage in Nanometer CMOS Technologies", Springer, 2005

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC104.1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC104.2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC104.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC104.4	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC104.5	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC104.6	3	3	3	3	-	-	-	-	-	-	-	-	3	3
AVG	3	3	3	3	-	-	-	-	-	-	-	-	3	3

PEC105	MIXED SIGNAL IC DESIGN TESTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explore the fundamental concepts and applications of mixed-signal devices.
- To understand the purpose of testing.
- To evaluate the execution and performance of different testing procedures.
- To classify the types of DAC testing methods.
- To understand the principles and procedures involved in ADC testing.
- To analyze the characteristics of clock signals and serial data communication channels

UNIT-I: MIXED – SIGNAL TESTING 9

Common Types of Analog and Mixed- Signal Circuits – Applications of Mixed-Signal Circuits – Post Silicon Production Flow - Test and Packing – Characterization versus Production Testing - Test and Diagnostic Equipment - Automated Test Equipments – Wafer Probers – Handlers – E-Beam Probers – Focused Ion Beam Equipments – Forced –Temperature.

UNIT-II: MEASUREMENTS 9

Measurement Terminology - Repeatability, Bias, and Accuracy - Calibrations and Checkers - Tester Specifications - Reducing Measurement Error with Greater Measurement Time – Guard bands - Effects of Measurement Variability on Test Yield - Effects of Reproducibility and Process Variation on Yield - Statistical Process Control.

UNIT-III: DAC TESTING 9

Basics of Data Converters -Principles of DAC and ADC, Data Formats, Comparison of DAC and ADC, DAC Failure Mechanisms - Basic DC Tests - Transfer Curve Tests - Dynamic DAC Tests - Tests for Common DAC Applications.

UNIT-IV: ADC TESTING 9

ADC Testing Versus DAC Testing - ADC Code Edge Measurements - Edge Code Testing Versus Center Code Testing, Step Search and Binary Search Methods, Servo Method, Linear Ramp Histogram Method, Histograms to Code Edge Transfer

Curves, Rising Ramps Versus Falling Ramps, Sinusoidal Histogram Method - DC Tests and Transfer Curve Tests - Dynamic ADC Tests - Tests for Common ADC Applications.

**UNIT-V: CLOCK AND SERIAL DATA COMMUNICATIONS CHANNEL 9
MEASUREMENT**

Synchronous and Asynchronous Communications - Time-Domain Attributes of a Clock Signal - Frequency-Domain Attributes of a Clock Signal - Communicating Serially Over a Channel - Bit Error Rate Measurement - Methods to Speed Up BER Tests in Production - Deterministic Jitter Decomposition - Jitter Transmission Tests.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Analyze the fundamental concepts and practical applications of mixed-signal devices.
- Apply appropriate formulas to compute various measurement techniques used in mixed-signal testing.
- Acquire knowledge from the resultant of testing.
- Classify the types of DAC testing.
- Understand the methods of ADC testing.
- Learn the clock and Serial Data Communications Channels.

TEXT BOOKS:

1. Gordon W.Roberts, Friedrich Taenzler, Mark Burns, "An Introduction to Mixed-signal IC Test and Measurement" Oxford University Press, Inc.2012.
2. M.L.Bushnell and V.D.Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 2006.
3. Bapiraju Vinnakota, "Analog and mixed-signal test", Prentice Hall, 1998.

REFERENCES:

1. Stanley Leonard Hurst, "VLSI Testing: Digital and Mixed Analogue/digital Techniques", IET, 1998.
2. M. Bushnell and V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers.
3. Yichuang Sun, "Test and Diagnosis of Analogue, Mixed-signal and RF Integrated Circuits: The System on Chip Approach", IET, 2008.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC105.1	3	3	3	3	-	-	-	-	-	-	-	2	3	3
PEC105.2	3	3	2	2	-	-	-	-	-	-	-	2	3	2
PEC105.3	3	3	2	2	-	-	-	-	-	-	-	2	3	2
PEC105.4	3	3	3	2	-	-	-	-	-	-	-	2	1	2
PEC105.5	3	3	3	2	-	-	-	-	-	-	-	2	2	1
PEC105.6	3	3	3	2	-	-	-	-	-	-	-	2	1	1
AVG	3	3	3	2	-	-	-	-	-	-	-	2	2	2

OBJECTIVES:

- To understand Testing Philosophies.
- To analyze Fault Modelling Techniques.
- To develop ATPG Strategies.
- To evaluate Design for Testability.
- To implement Scan Design Techniques
- To recognize the current trends and advancements in VLSI technology and testing processes.

UNIT-I: INTRODUCTION TO TESTING 9

Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends Affecting Testing. VLSI testing process, types of testing, Automatic test Equipment, Delay Test.

UNIT-II: FAULT MODELLING AND SIMULATION 9

Defects, errors, Faults, Functional versus Structural testing, Levels of Fault models, Single stuck-at-fault - Modelling circuits for Simulation, Algorithms for True Value and Fault simulation, Statistical methods for Fault simulation.

UNIT-III: ATPG FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS 9

Combinational Circuit: Algorithms and Representations, Redundancy Identification (RID), Significant Combinational ATPG Algorithms - D-Calculus and D-Algorithm, PODEM, FAN, Advanced Algorithms - Test Generation Systems, Test Compaction. **Sequential Circuit:** ATPG for Single-Clock Synchronous Circuits, Time-Frame Expansion Method, Simulation-Based Sequential Circuit ATPG - CONTEST Algorithm, Genetic Algorithms.

UNIT-IV: DESIGN FOR TESTABILITY 9

Introduction, Testability Analysis, SCOAP Testability Analysis, Combinational Controllability and Observability Calculation, Sequential Controllability and

Observability Calculation – Probability based Testability Analysis, Simulation Based Testability Analysis, RTL Testability Analysis, Design for Testability Basics

UNIT-V: SCAN DESIGN

9

Scan Cell Designs, Scan Architectures, Scan Design Rules, Scan Design Flow, Special Purpose Scan Designs, RTL Design for Testability

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Articulate the testing philosophies and the importance of VLSI testing in the lifecycle of digital and analog circuits
- Differentiate between functional and structural testing, and identify the appropriate fault models and simulation methods for VLSI testing scenarios.
- Utilize combinational and sequential ATPG algorithms effectively to generate test patterns that detect faults in VLSI circuits.
- Perform comprehensive testability analysis using SCOAP and probability-based analysis to determine the controllability and observability of circuit components.
- Design and implement scan-based testability solutions that adhere to industry standards, improving the test coverage and fault detection capabilities of VLSI designs.
- Evaluate and interpret the impact of emerging trends in VLSI technology on the testing processes and methodologies, adapting to new tools and techniques as necessary.

TEXT BOOKS:

1. M.L. Bushnell, V. D. Agrawal, “Essentials of Electronic Testing for Digital, Memory, and Mixed Signal VLSI Circuits”, Kluwer Academic Publishers, 2013.
2. Laung Terng Wang, Chen-Wen Wu, Xiaoging Wen, “VLSI Test Principles and Architectures: Design for Testability”, Elsevier Publications, 2006.

REFERENCES:

1. Samiha Mourad, Yervant Zorian, "Principles of Testing Electronic Systems", A Wiley Interscience Publications, 2002.
2. Alexander Miczo, "Digital Logic Testing and Simulation", Second Edition, A John Wiley & Sons Inc. Publication, 2003.
3. Abramovici, M, Breuer, M.A and Friendman, A.D., Digital systems and Testing and Testable Design, Computer Science Press 1990.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC106.1	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC106.2	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC106.3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC106.4	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC106.5	3	3	3	3	-	-	-	-	-	-	-	-	3	3
PEC106.6	3	3	3	3	-	-	-	-	-	-	-	-	3	3
AVG	3	3	3	3	-	-	-	-	-	-	-	-	3	3

PEC201	ADVANCED DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the mathematical description of random signal processing
- To learn the concept of prediction theory and filtering
- To estimate the power spectral density of random process
- To design an adaptive filters for nonstationary signals
- To explore the multistage system with different sampling rates
- To apply the concept of adaptive filter and multirate signal processing for various applications

UNIT-I: DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete Random Processes, Autocorrelation, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes: ARMA, AR, MA models – Relationship between autocorrelation and the filter parameters.

UNIT-II: LINEAR PREDICTION AND FILTERING 9

Linear Prediction – Forward and Backward - Wiener filters for filtering and prediction – FIR Wiener Filter – IIR Wiener Filter – Kalman Filter.

UNIT-III: SPECTRAL ESTIMATION 9

Estimation of power spectra from finite duration signals, Non parametric methods – Periodogram, Modified Periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods – ARMA, AR and MA model based spectral estimation.

UNIT-IV: ADAPTIVE FILTERS 9

Principles of adaptive filter - FIR adaptive filters – Newton's Steepest descent algorithm - LMS algorithm - Applications: Adaptive noise cancellation, adaptive channel equalization, adaptive echo cancellation - RLS algorithm.

UNIT-V: MULTIRATE SIGNAL PROCESSING**9**

Decimation, Interpolation, sampling rate conversion by rational factor, filter design and implementation for sampling-rate conversion, multistage implementation of sampling-rate conversion, sampling-rate conversion of bandpass signals; application: subband coding of speech signals - quadrature mirror filter.

TOTAL : 45 Periods**COURSE OUTCOMES:**

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

- Understand the basic theory of random processes used for signal processing
- Apply linear prediction and filtering techniques to discrete random signals for signal detection and estimation
- Estimate the power spectrum of random signals in the presence of noise
- Design adaptive filters for processing nonstationary signals of different applications
- Interpret the principles of system design that works with subsystems working with different sampling rates
- Propose the system for given application using adaptive filter and multi-rate signal processing

TEXT BOOKS:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons, New York, Indian reprint 2008.
2. John J. Proakis, Dimitris G. Manolakis, "Digital Signal Processing – Principles, Algorithms & Applications", Fourth Edition, Pearson Education/ Prentice Hall, 2007
3. D.G. Manolakis, V.K. Ingle and S.M. Kogon, Statistical and Adaptive Signal Processing, Artech House Publishers, 2005.

REFERENCES:

1. Steven. M. Kay, Modern Spectral Estimation, Theory and Application, Pearson India, 2009

2. Haykin, Adaptive Filter Theory, 4th Edition, Pearson Education, New Delhi, 2008.
3. S Nandi, D Kundu, Statistical Signal Processing- Frequency Estimation, Springer Nature Singapore, 2nd edition , 2020
4. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, Statistical Signal Processing with Applications, PHI, 1996.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC201.1	2	3	3	2	-	-	-	-	-	-	-	2	2	2
PEC201.2	2	3	3	2	-	-	-	-	-	-	-	2	2	2
PEC201.3	2	3	2	2	-	-	-	-	-	-	-	2	2	2
PEC201.4	2	3	3	2	-	-	-	-	-	-	-	2	2	2
PEC201.5	2	3	3	2	-	-	-	-	-	-	-	2	2	2
PEC201.6	1	2	3	2	-	-	-	-	-	-	-	2	2	2
AVG	2	3	3	2	-	-	-	-	-	-	-	2	2	2

PEC202	DSP ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the architecture of programmable DSP processors.
- To understand the TMS320C5X DSP processor architecture and instructions.
- To explore the TMS320C6X DSP processor architecture and instructions.
- To interpret the functions and operations of the DSP processors.
- To analyze the different DSP algorithms.
- To apply the concept of DSP processors to build real-time DSP systems.

UNIT-I: ARCHITECTURES FOR PROGRAMMABLE DSP PROCESSORS 9

Basic Architectural features, DSP Computational building blocks, Bus architecture and memory, Data addressing capabilities, Address generation Unit, Programmability and program execution, Speed issues, Features for external interfacing.

UNIT-II: TMS320C5X PROGRAMMABLE DSP PROCESSOR 9

Architecture of TMS320C54xx DSP processors, Addressing modes – Assembly language Instructions -Memory space, interrupts, and pipeline operation of TMS320C54xx DSP Processor, On-Chip peripherals, Block Diagram of TMS320C54xx DSP starter kit.

UNIT-III: TMS320C6X PROGRAMMABLE DSP PROCESSOR 9

Commercial TI DSP processors, Architecture of TMS320C6x DSP Processor, Linear and Circular addressing modes, TMS320C6x Instruction Set, Assembler directives, Linear Assembly, Interrupts, Multichannel buffered serial ports, Block diagram of TMS320C67xx DSP Starter Kit and Support Tools.

UNIT-IV: IMPLEMENTATION OF DSP ALGORITHMS 9

DSP Development system, On-chip, and On-board peripherals of C54xx and C67xx DSP development boards, Code Composer Studio (CCS) and support files, Implementation of Conventional FIR, IIR, and Adaptive filters in

TMS320C54xx/TMS320C67xx DSP processors for real-time DSP applications, Implementation of FFT algorithm for frequency analysis in real-time.

UNIT-V: APPLICATIONS OF DSP PROCESSORS 9

Voice scrambling using filtering and modulation, Voice detection and reverse playback, Audio effects, Graphic Equalizer, Adaptive noise cancellation, DTMF signal detection, Speech thesis using LPC, Automatic speaker recognition.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the architectural features of DSP processors.
- Comprehend the organization of programmable DSP processors.
- Frame (identify) the solutions using TMS320C5x DSP processor.
- Differentiate the TMS320C5x and TMS320C6x processors.
- Implement DSP algorithms in various methods.
- Utilize the DSP processors for the real time applications.

TEXT BOOKS:

1. Avtar Singh and S. Srinivasan, Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx, Cengage Learning India Private Limited, Delhi 2012.
2. Rulph Chassaing and Donald Reay, Digital Signal Processing and Applications with the TMS320C6713 and TMS320C6416 DSK, Second Edition, Wiley India (P) Ltd, New Delhi, 2008.

REFERENCES:

1. B.Venkataramani and M.Bhaskar, “Digital Signal Processors – Architecture, Programming and Applications”, Tata McGraw – Hill Publishing Company Limited. New Delhi, 2003.
2. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, Statistical Signal Processing with Applications, PHI, 2001.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC202.1	3	3	3	2	-	-	-	-	-	-	-	-	3	3
PEC202.2	3	3	2	2	-	-	-	-	-	-	-	-	3	3
PEC202.3	3	3	3	2	-	-	-	-	-	-	-	-	2	2
PEC202.4	3	3	3	3	-	-	-	-	-	-	-	-	2	3
PEC202.5	3	3	3	2	-	-	-	-	-	-	-	-	2	3
PEC202.6	3	3	3	2	-	-	-	-	-	-	-	-	2	3
AVG	3	3	3	2	-	-	-	-	-	-	-	-	2	3

OBJECTIVES:

- To study about the fundamentals of speech and speech model.
- 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
PEC203.1	2	2	2	2	-	-	-	-	-	-	-	2	2	2
PEC203.2	3	3	2	2	-	-	-	-	-	-	-	2	2	2
PEC203.3	3	3	2	2	-	-	-	-	-	-	-	2	2	2
PEC203.4	3	3	2	2	-	-	-	-	-	-	-	2	2	2
PEC203.5	3	3	2	2	-	-	-	-	-	-	-	2	2	2
PEC203.6	3	3	2	2	-	-	-	-	-	-	-	2	2	2
AVG	3	3	2	2	-	-	-	-	-	-	-	2	2	2

OBJECTIVES:

- To understand about the digital image fundamentals.
- To get exposed to image enhancement techniques in Spatial and Frequency domain.
- To analyze the restoration function and its techniques.
- To learn the image segmentation techniques.
- To become familiar with image compression methods.
- To explore the image recognition methods.

UNIT-I: DIGITAL IMAGE FUNDAMENTALS 9

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT-II: IMAGE ENHANCEMENT 9

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

UNIT-III: IMAGE RESTORATION 9

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

UNIT-IV: IMAGE SEGMENTATION 9

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

UNIT-V: IMAGE COMPRESSION AND RECOGNITION**9**

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

TOTAL : 45 Periods**COURSE OUTCOMES:**

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

- Know the basics of digital image processing, such as digitization, sampling.
- Operate on images using the techniques of smoothing, sharpening and enhancement.
- Understand the restoration concepts and filtering techniques.
- Apply the methods to segmentation of gray scale or RGB images
- Comprehend image compression concepts.
- Assess the image recognition methods.

TEXT BOOKS:

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

REFERENCES:

1. Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas Publishing House, 2nd edition, 1999.
2. William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002
3. Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB', Pearson Education, Inc., 2011.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC204. 1	3	1	2	1	-	-	-	-	-	-	-	3	3	-
PEC204. 2	2	1	3	2	-	-	-	-	-	-	-	2	3	-
PEC204. 3	2	1	3	2	-	-	-	-	-	-	-	2	3	-
PEC204. 4	2	2	3	2	-	-	-	-	-	-	-	2	3	3
PEC204. 5	2	2	3	1	-	-	-	-	-	-	-	2	3	3
PEC204. 6	2	2	3	2	-	-	-	-	-	-	-	2	3	3
AVG	2	2	3	2	-	-	-	-	-	-	-	2	3	3

OBJECTIVES:

- To learn the concepts of software radios.
- To understand about RF implementation challenges for software defined radios.
- To analyze the performance of the direct digital synthesis.
- To design and Implement the digital modulation schemes using SDR.
- To explore the software and hardware requirements for software defined radios.
- To design and develop the real time applications using SDR.

UNIT-I: INTRODUCTION TO SOFTWARE RADIO 9

SDR concepts & history, The Need for Software Radios. Characteristics and Benefits of a Software Radio. Design Principles of a Software Radio.

UNIT-II: RF IMPLEMENTATION 9

Purpose of RF front – end, Dynamic range, RF receiver front – end topologies, Enhanced flexibility of the RF chain with software radios, Importance of the components to overall performance, Transmitter architectures and their issues, Noise and distortion in the RF chain, Hybrid DDS – PLL systems.

UNIT-III: DIRECT DIGITAL SYNTHESIS 9

Comparison of direct digital synthesis with analog signal synthesis, Approaches to direct digital synthesis, Analysis of spurious signals, Performance of direct digital synthesis systems, Applications of direct digital synthesis.

UNIT-IV: SMART ANTENNAS 9

Benefits of smart antennas, Structures for beamforming systems, Smart antenna algorithms, Hardware implementation of smart antennas, Digital Hardware Choices-Key hardware elements.

UNIT-V: HARDWARE AND SOFTWARE FOR SDR & CASE STUDIES 9

DSP Processors, FPGA, ASICs. Trade-offs, Object oriented programming, Object Brokers, GNU Radio-USRP. Case Studies: SPEAK easy, JRTS, SDR-3000.

COURSE OUTCOMES:

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

- Illustrate the basic concepts of software defined radio and technologies.
- Understand the evolving paradigm of software defined radio and technologies for its implementation.
- Comprehend radio frequency implementation issues.
- Analyze smart antenna techniques for software defined radio.
- Explore the hardware and software requirements for software defined radios.
- Compare various digital synthesis procedures and its applications.

TEXT BOOKS :

1. Jeffrey Hugh Reed, "Software Radio: A Modern Approach to Radio Engineering," Prentice Hall Professional, 2002.
2. Tony J Roupael, "RF and DSP for SDR," Elsevier Newnes Press, 2008.

REFERENCES:

1. P. Kenington, "RF and Baseband Techniques for Software Defined Radio," Artech House, 2005.
2. Paul Burns, "Software Defined Radio for 3G," Artech House, 2002.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC205.1	2	2	2	2	-	-	-	-	-	-	-	-	2	2
PEC205.2	3	3	2	2	-	-	-	-	-	-	-	-	2	2
PEC205.3	3	3	2	2	-	-	-	-	-	-	-	-	2	2
PEC205.4	3	3	2	2	-	-	-	-	-	-	-	-	2	2
PEC205.5	3	3	2	2	-	-	-	-	-	-	-	-	2	2
PEC205.6	3	3	2	2	-	-	-	-	-	-	-	-	2	2
AVG	3	3	2	2	-	-	-	-	-	-	-	-	2	2

OBJECTIVES:

- Understand fundamentals of image processing and computer vision.
- Describe and explain basic principles of digital image processing
- To identify and apply image segmentation and feature extraction methods.
- Acquire knowledge about various Object Detection, Object Recognition, Motion estimation techniques and their applications.
- Assess the performance of image processing algorithms and systems
- Ability to apply various Image processing and Computer vision algorithms to solve real time problems.

UNIT-I: FUNDAMENTALS 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: APPLICATIONS

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

- To understand basic knowledge, theories and methods in image processing and computer vision.
- To implement basic and some advanced image processing techniques in OpenCV.
- To apply 2D a feature-based based image alignment, segmentation and motion estimations.
- To apply 3D image reconstruction techniques
- To design and develop innovative image processing and computer vision applications.
- To develop the system for given application using the processing, mining of visual content surveillance, advanced rendering.

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.
4. K. Fukunaga; Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
PCS206.1	3	3	3	3	-	-	-	-	-	-	-	-
PCS206.2	3	3	3	3	-	-	-	-	-	-	-	-
PCS206.3	3	3	3	3	-	-	-	-	-	-	-	-
PCS206.4	3	3	3	3	-	-	-	-	-	-	-	-
PCS206.5	3	3	3	3	-	-	-	-	-	-	-	-
AVG	3	3	3	3	-	-	-	-	-	-	-	-

OBJECTIVES:

- To familiarize with the concepts of active RF devices and their applications.
- To analyze the aspects of frequency planning and diversity techniques.
- To describe the various active components of radio frequency circuits.
- To explore the Receiver Architectures with their issues.
- To apply the basic techniques needed for analysis of RF systems and MIC Components.
- To impart the knowledge of microwave Integrated Circuits in real time applications.

UNIT-I: ACTIVE RF COMPONENTS and networks 9

RF diodes, BJT, RF FETs, High electron mobility transistors; Matching and Biasing Networks – Impedance matching using discrete components, Microstrip line matching networks, Amplifier classes of operation and biasing networks.

UNIT-II: RF SYSTEM DESIGN 9

Frequency Planning – Blockers, Spurs and Descending, Transmitter Leakage, LO Leakage and Interference, Image, Half IF, Link Budget Analysis – Linearity, Noise, Signal-to-Noise Ratio, Receiver Gain, Propagation Effects – Path Loss, Multipath and Fading, Equalization and Diversity Techniques.

UNIT-III: MIC COMPONENTS 9

Introduction to MICs, Fabrication Technology, Advantages and applications, MIC components- Micro strip components, Coplanar circuits: Transistors, switches, Coplanar microwave amplifiers: LNA design and Medium power amplifiers,

UNIT-IV: RECEIVER ARCHITECTURES 9

Heterodyne Receivers, Image Reject Receivers – Hartley Architectures, Weaver Architectures, Zero IF Receivers, Low IF Receivers, Issues in Direct Conversion Receivers – Noise, LO Leakage and Radiation, Phase and amplitude imbalance, DC offset, Intermodulation, Architecture Comparison and Trade-off.

UNIT-V: RECEIVER FRONT END MEASUREMENT**9**

DC Test, Functionality Test, S-Parameter Test, Conversion Gain Test, Linearity Test, Noise Figure Test, I/Q Imbalance, Introduction to Microwave CAD Tools (ADS, HFSS), Simulation of MIC and RF Circuits – Practical Design Examples.

TOTAL : 45 Periods**COURSE OUTCOMES:**

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

- Identify and describe the components and its applications of RF Systems.
- Understand the knowledge of different Transceiver Architecture in RF System Design.
- Utilize simulation tools for designing and analyzing RF systems.
- Evaluate and analyze the performance of RF circuits.
- Design and examine the various MIC components for practical applications.
- Integrate design, fabrication, and testing techniques in microwave engineering.

TEXT BOOKS:

1. B.Razavi, "RF Microelectronics", 3rd edition, Pearson Education, 2021.
2. Joy Laskar, Babak Matinpour, Sudipto Chakraborty, "Modern Receiver Front-Ends Systems, Circuits, and Integration", Wiley- Interscience, 2004.
3. Reinhold Ludwig and Powel Bretchko, "RF Circuit Design – Theory and Applications", 1st Edition, Pearson Education Asia, 2011.

REFERENCES:

1. T. Lee, "Design of CMOS RF Integrated Circuits", Cambridge University, 2004.
2. Joseph. J. Carr, "Secrets of RF Circuit Design", McGraw Hill Publishers, Third Edition, 2000.
3. Matthew M. Radmanesh, "Radio Frequency and Microwave Electronics", Pearson Education, 2015.

4. David M. Pozar, "Microwave Engineering", John Wiley & Sons, 4th edition 2013.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC301.1	3	3	3	3	-	-	-	-	-	-	-	-	1	3
PEC301.2	3	3	3	2	-	-	-	-	-	-	-	-	1	2
PEC301.3	3	3	3	3	-	-	-	-	-	-	-	-	2	2
PEC301.4	3	2	3	2	-	-	-	-	-	-	-	-	2	2
PEC301.5	3	3	3	3	-	-	-	-	-	-	-	-	2	2
PEC301.6	3	3	3	3	-	-	-	-	-	-	-	-	2	2
AVG	3	3	3	3	-	-	-	-	-	-	-	-	2	2

COURSE OUTCOMES:

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

- Describe diverse real-world applications of RFID technology across the industries.
- Analyze the different RFID standards and protocols for real time applications
- Apply the knowledge of RFID principles to solve the problems of tag selection, reader configuration, and antenna placement.
- Categorize the common data integrity and security vulnerabilities in RFID systems.
- Illustrate the key concepts and principles of RFID technology.
- Design RFID antenna for real time applications.

TEXT BOOKS:

1. Roy Want, RFID Explained: A Primer on Radio Frequency Identification Technologies , Springer, 2007.
2. Amin Rida, Li Yang, Manos M. Tentzeris, RFID Enabled Sensor Design and Applications, Artech House, 2010.

REFERENCES:

1. Klaus Finkenzeller, RFID Handbook, 3rd Edition, Wiley, 2010
2. Paris Kitsos, Security in RFID and Sensor Networks, CRC Press, 2016.
3. V. Daniel Hunt, Alber Puglia, Mike Puglia, "RFID: A guide for radio frequency identification", Wiley & Sons, Inc., Publication, 2011

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC 302.1	3	3	3	2	-	-	-	-	-	-	-	2	3	2
PEC 302.2	3	3	3	3	-	-	-	-	-	-	-	2	3	2
PEC 302.3	3	3	3	2	-	-	-	-	-	-	-	2	3	2
PEC 302.4	3	3	3	2	-	-	-	-	-	-	-	2	3	2
PEC 302.5	3	3	3	2	-	-	-	-	-	-	-	2	3	2
PEC 302.6	3	3	3	3	-	-	-	-	-	-	-	2	3	3
AVG	3	3	3	2	-	-	-	-	-	-	-	2	3	2

OBJECTIVES:

- To identify sources affecting the speed of digital circuits.
- To categorize the methods to improve the signal transmission characteristics.
- To characterize and model the multiconductor transmission line.
- To explore clock distribution system and its design parameters.
- To analyse the non-ideal effects of transmission line.
- To comprehend the characteristic impedance of transmission line and impedance matching techniques.

UNIT-I: SIGNAL PROPAGATION ON TRANSMISSION LINES 9

Transmission line equations, wave solution and bounce diagrams- Reactive terminations – L, C, static field maps of micro strip and strip line cross-sections, per unit length parameters, PCB layer stackups and layer/Cu thicknesses, cross-sectional analysis tools, Zo and Td equations for microstrip and stripline Reflection and terminations for logic gates, fan-out, logic switching.

UNIT-II: MULTI-CONDUCTOR TRANSMISSION LINES 9

Multi-conductor transmission-lines, coupling physics, Near and far-end cross-talk, minimizing cross-talk (stripline and microstrip) Differential signalling, termination, balanced circuits ,S-parameters, Lossy and Lossless models.

UNIT-III: NON-IDEAL EFFECTS 9

Non-ideal signal return paths – gaps, BGA fields, via transitions, Parasitic inductance and capacitance, Transmission line losses – Rs, $\tan\delta$, routing parasitic, Common-mode current, differential-mode current, Connectors.

UNIT-IV: POWER CONSIDERATIONS AND SYSTEM DESIGN 9

SSN/SSO, DC power bus design, layer stack up, SMT decoupling, Logic families, power consumption, and system power delivery, Logic families and speed Package types and parasitic, SPICE, IBIS models, Bit streams, PRBS and filtering functions of link-path components, Timing analysis.

UNIT-V: CLOCK DISTRIBUTERS AND OSCILLATORS**9**

Timing margin, Clock slew, low impedance drivers, terminations, Delay Adjustments, canceling parasitic capacitance, Clock jitter.

TOTAL : 45 Periods**COURSE OUTCOMES:**

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

- Familiar with transmission line characterization due to high speed signal propagation.
- Categorize the impairments, crosstalk and non-ideal effects associated with high speed design.
- Emphasize the sources affecting the speed of digital circuits and their analysis.
- Understand the power and clock related challenges in high speed system design.
- Interpret the methods to improve the signal transmission characteristics.
- Apply the knowledge on understanding of the basic principles of high speed design signal integrity system and the transmission methodologies.

TEXT BOOKS:

1. H. W. Johnson and M. Graham, "High-Speed Digital Design: A Handbook of Black Magic", Prentice Hall, 1993.
2. Douglas Brooks, "Signal Integrity Issues and Printed Circuit Board Design", Prentice Hall PTR, 2012.

REFERENCES:

1. S. Hall, G. Hall, and J. McCall, "High-Speed Digital System Design: A Handbook of Inter connect Theory and Design Practices", Wiley-Inderscience, 2014.
2. Eric Bogatin, "Signal Integrity – Simplified", Prentice Hall PTR, 2010.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	1	12	1	2
PEC303.1	2	3	2	2	-	-	-	-	-	-	-	3	2	2
PEC303.2	2	2	3	2	-	-	-	-	-	-	-	2	2	2
PEC303.3	2	2	3	2	-	-	-	-	-	-	-	2	2	2
PEC303.4	2	2	3	2	-	-	-	-	-	-	-	2	2	2
PEC303.5	2	2	3	2	-	-	-	-	-	-	-	2	2	2
PEC303.6	2	2	3	2	-	-	-	-	-	-	-	2	2	2
AVG	2	2	3	2	-	-	-	-	-	-	-	2	2	2

OBJECTIVES:

- To understand the fundamentals of RF system design.
- To familiar with the components of RF system for wireless communications.
- To know the basic techniques needed for analysis of RF systems.
- To enable the students to verify the basic principles and design aspects involved in RF systems components.
- To interpret data to produce meaningful conclusion and match with theoretical concepts.
- To design voltage controlled oscillators and PLL for RF circuits.

UNIT-I: TRANSCEIVER ARCHITECTURES 9

CMOS: Introduction to MOSFET Physics - Noise: Thermal, shot, flicker, popcorn noise - Transceiver Specifications: Two port Noise theory, Noise Figure, THD, IP₂, IP₃, Sensitivity, SFDR - Phase noise - Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low-IF Architectures - Transmitter: Direct-up conversion, Two-step up conversion schemes.

UNIT-II: IMPEDANCE MATCHING NETWORKS AND AMPLIFIERS 9

Review of S-parameters and Smith chart - Passive IC components - Impedance matching networks - Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement - High frequency amplifier design - Low Noise Amplifiers: Power match and Noise match, single-ended and differential LNAs.

UNIT-III: FEEDBACK SYSTEMS AND POWER AMPLIFIERS 9

Feedback Systems: Stability of feedback systems, Gain and phase margin, Root-locus techniques, Time and Frequency domain considerations, Compensation - Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers - Linearization Techniques - Efficiency boosting techniques - ACPR metric.

UNIT-IV: FILTERS, OSCILLATORS AND MIXERS 9

Overview - basic resonator and filter configuration, special filter realizations, filter implementation - Basic oscillator model, high-frequency oscillator configuration, Colpitt's oscillator - basic characteristics of mixers, single and double-balanced mixers.

UNIT-V: PLL AND FREQUENCY SYNTHESIZERS 9

PLL: Linearized Model, Noise properties, Phase detectors, Loop filters and Charge pumps Frequency Synthesizers: Integer-N frequency synthesizers - Direct Digital Frequency Synthesizers.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Interpret the nonlinear effects in RF circuits.
- Apply the RF circuits for wireless communications.
- Analyze the performance of RF circuits.
- Identify a suitable architecture and systematically design an RF System.
- Validate the experimentally measured data.
- Design voltage controlled oscillators and PLL for RF applications.

TEXT BOOKS:

1. Lee T, Design of CMOS RF Integrated Circuits, Cambridge, Second Edition, 2004.
2. Razavi B, RF Microelectronics, Pearson Education, Second Edition, 2012.

REFERENCES:

1. Ludwig R, and Bretchko P, RF Circuit Design Theory and Applications, Prentice Hall, 2000
2. Razavi B, Design of Analog CMOS Integrated Circuits, McGraw Hill, Second Edition, 2017
3. Kyung-WhanYeom, Microwave Circuit Design - A Practical Approach using ADS, Pearson Education, 2015.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC304.1	3	3	2	3	-	-	-	-	-	-	-	2	-	3
PEC304.2	3	3	3	2	-	-	-	-	-	-	-	2	-	2
PEC304.3	3	3	2	2	-	-	-	-	-	-	-	2	1	2
PEC304.4	3	3	3	3	-	-	-	-	-	-	-	2	2	2
PEC304.5	3	2	3	3	-	-	-	-	-	-	-	2	3	2
PEC304.6	3	2	3	3	-	-	-	-	-	-	-	2	3	2
AVG	3	3	3	3	-	-	-	-	-	-	-	2	2	2

OBJECTIVES:

- Understand the fundamentals of **Electromagnetic Interference (EMI) and Electromagnetic Compatibility (EMC)**.
- Analyze sources and coupling mechanisms of EMI in electronic systems.
- Learn industry standards and regulatory requirements for EMI/EMC compliance.
- Explore testing methodologies for pre-compliance EMI/EMC evaluation.
- Develop hands-on experience with EMI shielding techniques and noise reduction methods.
- Interpret test reports and recommend solutions for EMC compliance.

UNIT-I: INTRODUCTION 9

EMI & EMC: Definitions, Importance, Applications - Types of EMI: Conducted, Radiated, Crosstalk, and Powerline Interference - EMI Sources: Switching Circuits, Power Converters, Transmission Lines - Case Studies on EMI Failures

UNIT-II: STANDARDS & REGULATIONS 9

Global EMC Standards: CISPR, FCC, IEC, MIL-STD-461, ISO 7637 - Compliance Testing vs. Pre-Compliance Testing - Classification of EMC Tests: Emissions, Immunity, Susceptibility - Laboratory Test Setups for Compliance

UNIT-III: EMI TESTING 9

Measurement by direct connection, inductively coupled devices, EMC antennas – Antenna parameters, Antennas for radiated emission testing, Wideband antennas - Magnetic field antennas, Type of antennas used in susceptibility testing.

UNIT-IV: MEASUREMENT EQUIPMENTS 9

EMI receiver, Spectrum Analyzers, RF power meter. Standards for immunity tests, Automatic EMC tests, Electromagnetic transient testing, Transient types, Continuous and transient signal.

UNIT-V: PRE-COMPLIANCE TESTING 9

Need for Pre-Compliance Testing; Intrasystem and Intersystem, Conducted Emission & Radiated Emission Testing, EMC - Developing an approach to EMC design - Process flow chart, Test Equipment: Spectrum Analyzers, LISNs, TEM Cells, EMI Filters; Grounding; Bonding, Isolation transformer, Transient suppressors; EMI Suppression Cables.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the EMI/EMC fundamentals, classification, and real-world impact.
- Identify EMI sources and coupling mechanisms in circuits.
- Apply EMI mitigation techniques such as shielding, grounding, and filtering.
- Interpret EMI/EMC standards (CISPR, FCC, MIL-STD) and compliance procedures.
- Analyze pre-compliance EMI/EMC tests using modern measurement tools
- Assess test reports and propose solutions for EMI reduction.

TEXT BOOKS:

1. Wyatt, Kenneth. Workbench Troubleshooting EMC Emissions (Volume 2): Simple Techniques for Radiated and Conducted Emissions Troubleshooting and Pre-Compliance Testing. N.p.: Independently Published, 2021.
2. André, Patrick G., Wyatt, Kenneth. EMI Troubleshooting Cookbook for Product Designers. United States: Institution of Engineering and Technology, 2014.

REFERENCES:

1. V.P.Kodali, "Engineering EMC Principles, Measurements and Technologies", IEEE Press, New York, 1996.
2. Paul, C.R., "Introduction to Electromagnetic Compatibility", 2nd ed., Wiley 2010.
3. David K. Cheng, "Field and Wave Electromagnetics", 2nd ed. Pearson Education, 2009.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC305.1	3	3	3	3	-	-	-	-	-	-	-	2	3	2
PEC305.2	3	2	2	2	-	-	-	-	-	-	-	2	3	2
PEC305.3	3	3	2	2	-	-	-	-	-	-	-	2	3	2
PEC305.4	3	3	2	3	-	-	-	-	-	-	-	2	3	2
PEC305.5	3	2	3	2	-	-	-	-	-	-	-	2	3	2
PEC305.6	3	3	2	3	-	-	-	-	-	-	-	2	3	2
AVG	3	3	2	3	-	-	-	-	-	-	-	2	3	2

OBJECTIVES:

- To learn the basic concepts of antenna arrays for smart antenna design.
- To apply the random processes for angle of AOA estimation.
- To analyze different algorithms used for AOA estimation.
- To explore the concepts of fixed weight beamforming.
- To illustrate the concept of adaptive beamforming.
- To evaluate the adaptive antenna arrays in communication systems.

UNIT-I: ANTENNA ARRAY FUNDAMENTALS 9

Array weighting: Beam steered and weighted arrays, Circular arrays, Rectangular planar arrays, Fixed beam arrays, Butler Matrices, Fixed sidelobe cancelling, Retrodirective arrays: Passive and active retrodirective arrays.

UNIT-II: ANGLE OF ARRIVAL ESTIMATION 9

Array Correlation Matrix, AOA Estimation Methods: Bartlett AOA estimate, Capon AOA estimate, Linear prediction AOA estimate, Maximum entropy AOA estimate, Pisarenko harmonic decomposition AOA estimate, Min-norm AOA estimate, MUSIC AOA estimate, Root-MUSIC AOA estimate, ESPRIT AOA estimate.

UNIT-III: FIXED BEAMFORMING 9

Introduction, Historical development of smart antennas - Fixed weight beamforming basics: Maximum signal-to-interference ratio, Minimum mean-square error, Maximum likelihood, Minimum variance.

UNIT-IV: ADAPTIVE BEAMFORMING 9

Adaptive Beamforming: Least mean squares, Sample matrix inversion, Recursive least squares, Constant modulus, Least squares constant modulus, Conjugate gradient method, Spreading sequence array weights, Description of the new SDMA receiver.

UNIT-V: ADAPTIVE ANTENNA ARRAYS TRENDS 9

Adaptive antenna algorithms, Spatial dimension in wireless multicarrier communications, Constrained adaptive filters, Beamforming with genetic algorithms, Sidelobe control using optimization methods in adaptive beamforming, Adaptive linearly constrained beamforming algorithms for smart jamming suppression, Optical beamforming for phased array antennas.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Describe the basics of phased array antennas.
- Estimate the weights of the antenna array based on the angle of arrival.
- Analyze the fixed weight beamforming in smart antennas.
- Interpret adaptive beamforming in smart antennas.
- Evaluate the adaptive antenna arrays in communication systems.
- Design smart antennas for communications to meet the industrial requirements.

TEXT BOOKS:

1. Frank Gross, Smart antennas for wireless communications, McGraw-Hill, 2nd edition, 2015.
2. S. Chandran, Adaptive antenna arrays, trends and applications, Springer, 2011.

REFERENCES:

1. Robert A.Mozingo, Randy L. Haupt and Thomas W.Miller, Introduction to Adaptive arrays, 2nd Edition, IET, 2011.
2. T. S. Rappaport, Smart antennas: Adaptive arrays, algorithms and wireless position location, IEEE Press, 2008.
3. Thomas Kaiser, Smart Antennas: State of the Art, Hindawi, 2005.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC306.1	3	3	3	3	-	-	-	-	-	-	-	2	3	2
PEC306.2	3	2	2	2	-	-	-	-	-	-	-	2	3	2
PEC306.3	3	3	2	2	-	-	-	-	-	-	-	2	3	2
PEC306.4	3	3	2	3	-	-	-	-	-	-	-	2	3	2
PEC306.5	3	2	3	2	-	-	-	-	-	-	-	2	3	2
PEC306.6	3	3	2	3	-	-	-	-	-	-	-	2	3	2
AVG	3	3	2	3	-	-	-	-	-	-	-	2	3	2

OBJECTIVES:

The student should be made:

- To acquire knowledge about the methods of recording various bio potentials.
- To gain knowledge about the various physiological parameters both electrical and non-electrical parameters.
- To study about the various assist devices used in the hospitals.
- To obtain knowledge about equipment used for physical medicine.
- To explore the Biotelemetry techniques.
- To learn about the recent trends in medical instrumentation.

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

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

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

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

UNIT - III: ASSIST DEVICES 9

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

UNIT - IV: PHYSICAL MEDICINE AND BIOTELEMETRY 9

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

UNIT - V: RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

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

TOTAL : 45 Periods

OUTCOMES:

The student should be able to:

- Know the human body electro- physiological parameters and recording of bio-potentials.
- Comprehend the non-electrical physiological parameters and their measurement –body temperature, blood pressure, pulse, blood cell count, blood flow meter etc.
- Interpret the various assist devices used in the hospitals viz. pacemakers, defibrillators, dialyzers and ventilators.

- Realize physical medicine methods eg. ultrasonic, shortwave, microwave surgical diathermies.
- Apply bio-telemetry principles and methods for diagnostics.
- Analyze the recent trends in medical instrumentation.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC401.1	3	1	2	-	-	-	-	-	-	-	-	-	2	-
PEC401.2	3	3	2	-	-	-	-	-	-	-	-	-	2	-
PEC401.3	3	3	-	3	-	-	-	-	-	-	-	-	2	-
PEC401.4	3	3	1	3	-	-	-	-	-	-	-	-	3	3
PEC401.5	3	2	1	-	-	-	-	-	-	-	-	-	2	-
PEC401.6	3	3	3	2	-	-	-	-	-	-	-	-	2	1
Avg	3	2	2	3	-	-	-	-	-	-	-	-	2	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 understand the importance of rehabilitation and related aspects.

UNIT – I: CARDIAC ASSIST DEVICES**9**

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

UNIT – II: PROSTHETIC AND ORTHODIC DEVICES PROSTHESIS **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
Avg	3	2		3	3	3	2	2	-	-	-	3	2	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.
- To explore 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.

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

TOTAL PERIODS: 45

COURSE OUTCOMES:

On completion of the course, student will be able to

- Explain the basic principles of cardiac assist devices.
- Analyze the function of diathermy and medical stimulators.
- Interpret the operation of extra corporeal devices.
- Examine the functions of different respiratory assistance devices.
- Explore the radiation safety principles.
- Identify radiation protection methods in medicines.

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
PEC402.1	3	2	1	1	-	-	-	-	-	-	-	-	1	-
PEC402.2	3	2	1	1	-	-	-	-	-	-	-	-	1	-
PEC402.3	3	2	1	1	-	-	-	-	-	-	-	-	1	-
PEC402.4	3	2	1	1	-	-	-	-	-	-	-	-	1	-
PEC402.5	3	2	1	1	-	-	-	-	-	-	-	-	1	-
PEC402.6	3	2	1	1	-	-	-	-	-	-	-	-	1	-
Avg.	3	2	1	1	-	-	-	-	-	-	-	-	1	-

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
- To analyse 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. Block Diagram approach of MRI system- system Magnet (Permanent, Electromagnet and Super conductors), generations of gradient magnetic fields, Radio Frequency coils (sending and receiving), shim coils, contrast agents- tissue contrast in MRI- MR angiography, MR spectroscopy.

UNIT – IV: RADIO ISOTOPIC IMAGING AND INFRARED IMAGING 9

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

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
PEC403.1	3	2	1	1	-	-	-	-	-	-	-	-	1	-
PEC403.2	3	2	1	1	-	-	-	-	-	-	-	-	1	-
PEC403.3	3	2	1	1	-	-	-	-	-	-	-	-	1	-
PEC403.4	3	2	1	1	-	-	-	-	-	-	-	-	1	-
PEC403.5	3	2	1	1	-	-	-	-	-	-	-	-	1	-
PEC403.6	3	2	1	1	-	-	-	-	-	-	-	-	1	-
Avg	3	2	1	1	-	-	-	-	-	-	-	-	1	-

OBJECTIVES:

- To study about sensors and its application in wearable systems.
- To know about sensor design and signal acquisition.
- To gain knowledge in energy harvesting methods for wearable systems.
- To understand the need for wireless technology in wearable systems 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 FOR WEARABLE DEVICES**9**

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

UNIT – IV: WIRELESS HEALTH SYSTEMS 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 OF WEARABLE SYSTEMS

9

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

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 Bonfiglio 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: Fundamentals, Implementation and Applications, Elsevier, 2014
4. Mehmet R. Yuce and Jamil Y. 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

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

OBJECTIVES:

- To acquire knowledge about the basics of IoT.
- To familiarize the services provided by IoT.
- To describe the communication techniques and networking adopted in IoT.
- To analyse the implementation of IoT with different tools.
- To develop the Embedded system based IoT applications.
- To design complex systems for applications based on IoT technologies.

UNIT-I: INTRODUCTION TO INTERNET OF THINGS 9

Evolution of IoT – Definition and characteristics of IoT – IoT Enabling Technologies – IoT Architecture -- Functional blocks of an IoT ecosystem - Fog, Edge and Cloud in IoT — Sensors, Actuators, Smart Objects - IoT levels and deployment templates- Connecting Smart Objects

UNIT-II: MIDDLEWARE AND PROTOCOLS OF IOT 9

Middleware technologies for IoT system (IoT Ecosystem Overview – Horizontal Architecture Approach for IoT Systems – SOA based IoT Middleware) Middleware architecture of RFID, WSN, SCADA, M2M –Interoperability challenges of IoT- Protocols for RFID, WSN, SCADA, M2M- Zigbee, KNX, BACNet, MODBUS - Challenges Introduced by 5G in IoT Middleware(Technological Requirements of 5G Systems - Perspectives and a Middleware Approach Toward 5G (COMPaaS Middleware) – Resource management in IoT.

UNIT-III: COMMUNICATION AND NETWORKING 9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and LoRaWAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks – Application Layer Protocols: CoAP and MQTT- Data aggregation & dissemination.

UNIT-IV: IOT IMPLEMENTATION TOOLS**9**

Introduction to Python, Introduction to different IoT tools, Developing applications through IoT tools, Developing sensor based application through embedded system platform, Implementing IoT concepts with python, Implementation of IoT with Raspberry Pi.

UNIT-V: CASE STUDIES OF IOT**9**

Case study of Home automations - Smart cities – Environment – Energy – Retail – Logistics – Agriculture – Industry - Health and life style.

TOTAL: 45 Periods**COURSE OUTCOMES:**

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

- Articulate the main concepts, key technologies, strength and limitations of IoT.
- Understand the architecture, infrastructure models of IoT.
- Identify the networking technologies and how the sensors are communicated in IoT.
- Analyze and design different models for IoT implementation.
- Interpret the new models for market strategic interaction.
- Design, develop, and implement complete IoT systems.

TEXT BOOKS:

1. Honbo Zhou, "Internet of Things in the cloud:A middleware perspective", CRC press, 2012.
2. Vijay Madiseti and Arshdeep Bahga, "Internet of Things (A Hands-onApproach)", VPT, 1st Edition, 2014.

REFERENCES:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, 2017.

2. Constandinos X. Mavromoustakis, George Mastorakis, Jordi MongayBatalla, "Internet of Things (IoT) in 5G Mobile Technologies" Springer International Publishing Switzerland 2016.
3. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things" Springer-Verlag Berlin Heidelberg, 2011.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC501.1	3	3	2	2	-	-	-	-	-	-	-	3	3	3
PEC501.2	3	3	2	2	-	-	-	-	-	-	-	2	3	3
PEC501.3	3	3	3	2	-	-	-	-	-	-	-	2	3	2
PEC501.4	3	3	2	2	-	-	-	-	-	-	-	1	3	3
PEC501.5	3	2	3	3	-	-	-	-	-	-	-	1	3	2
PEC501.6	-	2	3	3	-	-	-	-	-	-	-	3	2	2
AVG	3	3	3	2	-	-	-	-	-	-	-	2	3	3

OBJECTIVES:

- To learn different materials used for MEMS.
- To understand the MEMS fabrication techniques.
- To know about different types of sensors and their principles of operation at the micro scale level.
- To design different types of actuators and their principles of operation at the micro scale level.
- To explore the features of nano-materials and sensors.
- To identify the applications of MEMS in the RF and optical domain.

UNIT-I: INTRODUCTION TO MEMS AND NEMS 9

MEMS and Microsystems, Miniaturization, Typical products, Micro sensors, Micro actuation, MEMS with micro actuators, Micro accelerometers and Micro fluidics, Introduction to NEMS, Nano scaling, classification of nano-structured materials, Applications of nano-materials. Synthesis routes – Bottom up and Top down approaches. Materials for MEMS: Silicon, silicon compounds, polymers, metals.

UNIT-II: MECHANICS FOR MEMS DESIGN 9

Elasticity, Stress, strain and material properties, Bending of thin plates, Spring configurations, torsional deflection, Mechanical vibration, Resonance, Thermo mechanics – actuators, force and response time, Fracture and thin film mechanics.

UNIT-III: MATERIALS AND FABRICATION OF MEMS 9

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics Photolithography, Ion Implantation, Diffusion, Oxidation, Dry and wet etching, Bulk Micromachining, Surface Micromachining, LIGA.

UNIT-IV: DESIGN OF MEMS SENSORS AND ACTUATORS 9

Acoustic sensor – Quartz crystal microbalance, Surface acoustic wave, Flexural plate wave, shear horizontal; Vibratory gyroscope, Pressure sensors, Electrostatic actuators, piezoelectric actuators, Thermal actuators, Actuators using shape

memory alloys, Micro grippers, Micro motors, Micro valves, Micro pumps, Packaging.

UNIT-V: OPTICAL AND RF MEMS

9

Optical MEMS, - System design basics – Gaussian optics, matrix operations, resolution. Case studies, MEMS scanners and retinal scanning display, Digital Micro mirror devices. RF MEMS-design, RF MEMS switch, performance issues. Packaging.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the basics of materials and fabrication of micro electromechanical systems.
- Explore the scaling laws used in the conceptual design of micro devices and systems.
- Compare various aspects of nano-materials and sensors.
- Analyze the key performance aspects of micro electromechanical sensors and transducers.
- Apply the fabrication techniques of nano-electromechanical systems
- Develop the applications of MEMS in the RF and optical domain.

TEXT BOOKS:

1. Chang Liu, Foundations of MEMS, Pearson Education Inc., 2012.
2. Murty B.S, Shankar P, Raj B, Rath, B.B, Murday J, Textbook of Nanoscience and Nanotechnology, Springer publishing, 2013.
3. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, Devices, and Structures”, CRC Press, 2002.

REFERENCES:

1. Vinod Kumar Khanna Nanosensors: Physical, Chemical, and Biological, CRC press, 2012.
2. Manouchehr E Motamedi, MOEMS: Micro-Opto-Electro-Mechanical Systems, SPIE press, First Edition, 2005.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC502.1	3	2	3	2	-	-	-	-	-	-	-	2	1	2
PEC502.2	2	3	3	2	-	-	-	-	-	-	-	2	1	1
PEC502.3	3	3	2	2	-	-	-	-	-	-	-	2	2	3
PEC502.4	3	3	3	3	-	-	-	-	-	-	-	2	2	3
PEC502.5	3	3	3	3	-	-	-	-	-	-	-	2	2	2
PEC502.6	3	3	3	2	-	-	-	-	-	-	-	2	2	2
AVG	3	3	3	2	-	-	-	-	-	-	-	2	2	2

OBJECTIVES:

- To understand the architecture and features of ARM.
- To describe the exception handling and interrupts in CORTEX M3
- To impart the programming knowledge in CORTEX M3.
- To analyze the architecture of STM 32L15XXX ARM CORTEX M3/M4 microcontroller
- To assess the blocks and of System – On – Chip (SoC)
- To get insights to choose the right processor for various IoT applications.

UNIT-I: OVERVIEW OF ARM AND CORTEX-M3 9

ARM Architecture – Versions, Instruction Set Development, Thumb 2 and Instruction Set Architecture, Cortex M3 Basics: Registers, Stack Pointer, Link Register, Program Counter, Special Registers, Operation Mode, Exceptions and Interrupts, Vector Tables, Stack Memory Operations, Reset Sequence, CORTEX M3 Instruction Sets: Assembly Basics, Instruction List, Instruction Descriptions.

UNIT-II: CORTEX EXCEPTION HANDLING AND INTERRUPTS 9

Exception Types, Priority, Vector Tables, Interrupt Inputs and Pending behaviour, Fault Exceptions, Supervisor Call and Pendable Service Call, NVIC: Nested Vector Interrupt Controller, Basic Interrupts, SYSTICK Time, Interrupt Behaviour and Interrupt/Exception Sequences, Exception Exits, Nested Interrupts, Tail – Chaining Interrupts, Late Arrivals and Interrupt Latency.

UNIT-III: CORTEX M3/M4 PROGRAMMING 9

Cortex M3/M4 Programming: Typical Development Flow, CMSIS Using ALP, Exception Programming Using Interrupts, Exception/Interrupt Handlers, Software Interrupts, Vector Table Relocation, Memory Protection Unit, MPU Registers, Setting up the MPU, Power Management, Multiprocessor Configuration.

UNIT-IV: ARMCORTEX M3/M4 MICROCONTROLLER AND DEBUGGING TOOLS 9

STM32L15XXX ARM CORTEX M3/M4 Microcontroller: Memory and Bus Architecture, Power Control, Reset and Clock Control, STM32L15XXX Peripherals: GPIOs, System Configuration Controller, NVIC, ADC, Comparators, GP Timers, USART Development and Debugging Tools: Software and Hardware tools - Cross Assembler Compiler, Debugger, Simulator, In-Circuit Emulator, Logic Analyser.

UNIT-V: INTRODUCTION TO SYSTEM – ON – CHIP 9

System Architecture: Components of the System Processors, Memories and Interconnects, Processor Architectures, Memory and Addressing, System Level Interconnection – An Approach for SOC Design – Chip basics – Cycle Time – Die Area – Power and Cost – Tradeoff in Processor Design – Reliability and Configurability – SOC Design Approach.

TOTAL: 45 Periods

COURSE OUTCOMES:

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

- Understand the architecture and features of ARM.
- Acquire knowledge about the concepts of exception handling.
- Write the programs using ARM CORTEX M3/M4.
- Analyze the features of STM32L15XXX ARM CORTEX M3/M4.
- Develop an SoC for any specific application.
- Design and present IoT projects to solve real-world problems using IoT processors.

TEXT BOOKS:

1. Joseph Yiu, The Definitive Guide to the ARM CORTEX M3/M4, Second Edition, Elsevier, 2010. (Unit – I, II).
2. Andrew N Sloss, Dominic Symes, Chris Wright, ARM System Developers Guide Designing and Optimising System Software, Elsevier, 2006 (Unit – III, IV).
3. Michael J Flynn and Wayne Luk, Computer System Design, System On Chip, Wiley India 2011. (Unit – V).

REFERENCES:

1. Steve Furber, ARM System – on – Chip Architecture, 2nd Edition, Pearson, 2015.
2. CORTEX M Series ARM Reference Manual.
3. CORTEX M3 Technical Reference Manual.
4. STM32L152XX ARM CORTEX M3 Microcontroller Reference Manual 5/97.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC503.1	3	3	3	2	-	-	-	-	-	-	-	3	2	2
PEC503.2	3	3	3	3	-	-	-	-	-	-	-	2	2	-
PEC503.3	3	3	3	3	-	-	-	-	-	-	-	2	2	-
PEC503.4	3	3	2	2	-	-	-	-	-	-	-	2	2	-
PEC503.5	3	3	2	2	-	-	-	-	-	-	-	3	2	-
PEC503.6	3	2	3	3	-	-	-	-	-	-	-	2	2	1
AVG	3	3	3	3	-	-	-	-	-	-	-	2	2	2

PEC504	WIRELESS SENSOR NETWORK DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the principles and architecture of wireless sensor networks (WSNs).
- To gain insight into the MAC and Routing protocols used in WSNs.
- To explore the 6LOWPAN technology.
- To acquire understanding of the protocols essential for developing real-time applications using WSNs and 6LOWPAN.
- To gain knowledge about operating systems related to WSNs and 6LOWPAN.
- To familiarise the tools involved in WSN design.

UNIT-I: INTRODUCTION 9

Principles of Wireless Sensor Network - Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT-II: MAC AND ROUTING PROTOCOLS 9

MAC protocols – low duty cycle protocols and wakeup concepts, contention and Schedule-based protocols - SMAC, BMAC, TRAMA, Routing protocols – Requirements, SPIN, Directed Diffusion, COUGAR, ACQUIRE, LEACH, PEGASIS.

UNIT-III: APPLICATION LAYER PROTOCOL 9

Design Issues, Protocol Paradigms -End-to-end, Real-time streaming and sessions, Publish/subscribe, Web service paradigms, Common Protocols -Web service protocols, MQ telemetry transport for sensor networks (MQTT-S), ZigBee compact application protocol (CAP), Service discovery, Simple network management protocol (SNMP), Real-time transport and sessions, Industry- Specific protocols.

UNIT IV 6LOWPAN 9

6LoWPAN Architecture - protocol stack, Adaptation Layer, Link layers – Addressing, Routing - Mesh- Under - Route-Over, Header Compression - Stateless header compression - Context based header compression, Fragmentation and Reassembly, Mobility – types, Mobile IPv6, Proxy Home Agent, Proxy MIPv6, NEMO –Routing – MANET, ROLL, Border routing.

UNIT-V: TOOLS

9

TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the principles and architectures of wireless sensor networks (WSNs).
- Illustrate the MAC and Routing protocols used in WSNs.
- Explore the 6LOWPAN technology.
- Analyse the protocols essential for developing real-time applications using WSNs and 6LOWPAN.
- Assess the operating systems related to WSNs and 6LOWPAN.
- Design and develop the WSN using different tools.

TEXT BOOKS:

1. Shelby, Zach., Bormann, Carsten. 6LoWPAN: The Wireless Embedded Internet. Germany: Wiley, 2011.
2. Yang, Shuang-Hua. Wireless Sensor Networks: Principles, Design and Applications. United Kingdom: Springer London, 2013.
3. Wireless Sensor Networks: Design, Deployment and Applications. United Kingdom: IntechOpen, 2021.
4. Levis, Philip., Gay, David E. TinyOS Programming. United Kingdom: Cambridge University Press, 2014.

REFERENCES:

1. F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.
2. YingshuLi, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

3. Ian F. Akyildiz , By (author) Mehmet Can Vuran, “Wireless Sensor Networks“ ,John Wiley & Sons Inc, 2011.
4. Kazem Sohraby , Daniel Minoli , Taieb Znati , “Wireless Sensor Networks : Technology, Protocols, and Applications “,John Wiley & Sons Inc, 2010.
5. Shuang-Hua Yang ,” Wireless Sensor Networks: Principles, Design and Applications “,Springer London Ltd, 2013.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC504.1	3	3	2	2	2	1	-	-	-	-	2	2	3	1
PEC504.2	3	3	2	2	2	1	-	-	-	-	-	2	3	2
PEC504.3	3	3	3	2	2	1	-	-	-	-	-	3	3	2
PEC504.4	3	3	3	3	2	2	-	-	-	-	-	2	2	1
PEC504.5	2	-	1	1	3	2	-	-	-	-	-	2	2	2
PEC504.6	-	1	-	1	1	-	-	-	-	-	-	-	1	1
AVG	3	3	2	2	2	1	-	-	-	-	2	2	3	2

OBJECTIVES:

- To understand basic industrial processes and its reference architecture
- To study the integration of modern technologies such as sensors, communication, and computational processing
- To perceive the knowledge of networks and programming of IIOT
- To assess the core concepts and gain meaningful insights into modern industrial manufacturing systems.
- To explore the computation and securities in IIOT
- To develop the application of IIOT in real time environment

UNIT-I: INTRODUCTION 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: FUNDAMENTALS OF INDUSTRY 4.0 9

Introduction: Sensing & Actuation, Communication, Networking- Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories. Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Augmented Reality and Virtual Reality, Artificial Intelligence, Big Data and Advanced Analysis.

UNIT-IV: COMPUTATION 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: 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

- Understand basic industrial processes and its reference architecture
- Comprehend to the modern technologies need for IIOT
- Illustrate the programming of IIOT
- Interpret the concepts and gain knowledge into modern industrial manufacturing systems.
- Analyse the real time security issues in IIOT
- Develop the 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. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

REFERENCES:

1. Vijay Madiseti 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
PEC505.1	1	3	3	2	-	-	-	-	-	-	-	3	2	2
PEC505.2	1	3	3	2	-	-	-	-	-	-	-	2	2	2
PEC505.3	2	3	2	2	-	-	-	-	-	-	-	2	2	3
PEC505.4	3	3	2	3	-	-	-	-	-	-	-	2	2	2
PEC505.5	3	3	3	2	-	-	-	-	-	-	-	2	2	2
PEC505.6	3	2	3	2	-	-	-	-	-	-	-	3	2	2
AVG	3	3	3	2	-	-	-	-	-	-	-	2	2	2

OBJECTIVES:

- To learn the basic concepts of nano electronics
- To understand the problem-solving skills in the field of quantum electronics.
- To explore the applications of nano electronic devices, transistors, tunneling devices and superconducting devices
- To gain the knowledge of nano electronic tunneling
- To analyse the design and fabrication of superconducting devices
- To gain expertise in the challenges associated with the development of nanodevices

UNIT-I: INTRODUCTION TO NANO ELECTRONICS 9

Overview of nanoscience and engineering-Development milestones in microfabrication and electronic industry -Moore's law and continued miniaturization- origin of quantum mechanics - General postulates of quantum mechanics - Time independent Schrodinger wave equation- Electron confinement - Quantum dots, wires and well-Spin and angular momentum.

UNIT-II: QUANTUM ELECTRONICS 9

Quantum electronic devices - Short channel MOS transistor - Split gate transistor - Electron wave transistor - Electron spin transistor - Quantum cellular automata - Quantum dot array- Quantum memory.

UNIT-III: NANO ELECTRONIC TRANSISTORS 9

Coulomb blockade - Coulomb blockade in Nano capacitors - Coulomb blockade in tunnel junctions - Single electron transistors, Semiconductor nanowire FETs and SETs, Molecular SETs and molecular electronics - Memory cell.

UNIT-IV: NANO ELECTRONIC TUNNELING AND SUPER CONDUCTING DEVICES 9

Tunnel effect - Tunneling element - Tunneling diode - Resonant tunneling diode - Three terminal resonant tunneling devices- Superconducting switching devices- Cryotron- Josephson tunneling devices.

UNIT-V: NANOTUBES AND NANOSTRUCTURE DEVICE 9

Carbon Nanotube: Fullerenes - types of nanotubes – formation of nanotubes – assemblies – purification of carbon nanotubes – electronic properties – synthesis of carbon nanotubes – carbon nanotube interconnects – carbon nanotube FETs – Nanotube for memory applications.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Discuss the potential applications and societal impact of nanoelectronics.
- Analyze the quantum behavior of electronic devices, such as transistors and diodes.
- Design and optimize nanoelectronic transistors for specific applications.
- Apply their knowledge to solve problems related to the design, fabrication, and performance of super conducting devices.
- Critically assess the advantages, limitations, and future directions of nanodevice research
- Analyze the synthesis, and characterization of carbon nanotubes and other nanomaterials.

TEXT BOOKS:

1. Hanson, Fundamentals of Nanoelectronics, Pearson education, 2009.
2. Robert Kelsall, Ian Hamley and Mark Geoghegan, "Nanoscale Science and Technology", John Wiley, 2007

REFERENCES:

1. Jan Dienstuhl, Karl Goser, and Peter Glösekötter, Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum Devices, Springer-Verlag, 2004.
2. Mircea Dragoman and Daniela Dragoman, Nanoelectronics: Principles and Devices, Artech House, 2009.
3. Robert Puers, Livio Baldi, Marcel Van de Voorde and Sebastiaan E. Van Nooten, Nanoelectronics: Materials, Devices, Applications, Wiley, 2017.
4. Brajesh Kumar Kaushik, Nanoelectronics: Devices, Circuits and Systems, Elsevier science, 2018

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC 506.1	3	2	2	1	-	-	-	-	-	-	-	2	3	3
PEC 506.2	3	3	3	2	-	-	-	-	-	-	-	1	2	3
PEC 506.3	3	3	3	2	-	-	-	-	-	-	-	2	2	3
PEC 506.4	3	3	3	2	-	-	-	-	-	-	-	1	2	3
PEC 506.5	3	3	3	2	-	-	-	-	-	-	-	1	2	3
PEC 506.6	3	3	3	2	-	-	-	-	-	-	-	2	2	3
AVG	3	3	3	2	-	-	-	-	-	-	-	2	2	3

PEC601	SATELLITE AND RADAR COMMUNICATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Satellite orbits.
- To learn the concept of Satellite segment.
- To know the operation of earth segment.
- To calculate the Link power budget.
- To explore the basics of Radar and Radar equation.
- To understand the Types of Radar.

UNIT-I: FUNDAMENTALS 9

Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and Non Geo-stationary orbits – Look Angle Determination- Limits of visibility – eclipse Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion.

UNIT-II: SPACE SEGMENT 9

Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders Antenna Subsystem.

UNIT-III: SATELLITE LINK DESIGN 9

Basic link analysis, Uplink and Downlink Design equation, Free space loss-Atmospheric effects, Ionospheric scintillation, Rain induced attenuation and interference, system noise temperature, Link Design with and without frequency reuse.

UNIT-IV: INTRODUCTION TO RADAR EQUATION 9

The Origins of Radar, Radar principles, Basic Block Diagram, Radar classifications based on Frequencies, Wave form and application, Radar Fundamentals: Detection, Range, velocity, The simple form of the Radar Equation, Pulsed Radar equation, Detection of Signals in Noise- Receiver Noise, Signal-to-Noise Ratio.

UNIT-V: CW, MTI AND PULSE DOPPLER RADAR 9

CW and Frequency Modulated Radar, Doppler and MTI Radar- Delay Line Cancellers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Explore the concept of satellite orbits
- Understand the functionality of satellite subsystems
- Analyze the Satellite Link design
- Evaluate the satellite link power budget
- Describe the Radar parameters.
- Differentiate various radar types

TEXT BOOKS:

1. Dennis Roddy, "Satellite Communication", 4th Edition, Mc Graw Hill International, 2017.
2. Timothy Pratt, Charles W. Bostain, Jeremy E. Allnutt, "Satellite Communication", 3rd Edition, Wiley Publications, 2021.
3. Habibur Rahman, Fundamental Principles of Radar, CRC press, Taylor and Francis, 2019.
4. M. R. Richards, J. A. Scheer, W. A. Holm, Editors "Principles of Modern Radar, Basic Principles", SciTech Publishing, 2012

REFERENCES:

1. Tri T. Ha, "Digital Satellite Communications", 2nd edition, Mc Graw Hill education, 2017.
2. M. Richharia, "Satellite Communication Systems-Design Principles", Macmillan, 1999.
3. Nathansan, "Radar design principles-Signal processing and environment", PHI, 2nd Edition, 2007.
4. M.I. Skolnik, "Introduction to Radar Systems", Tata McGraw Hill 2006.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC601.1	3	2	2	-	3	-	2	-	2	2	-	3	2	2
PEC601.2	2	2	3	2	3	2	2	-	2	2	-	2	2	-
PEC601.3	2	2	3	-	3	1	-	1	2	2	-	2	2	-
PEC601.4	1	2	3	2	3	-	2	-	1	2	-	2	2	-
PEC601.5	1	1	3	1	3	2	-	-	2	2	-	2	2	-
PEC601.6	1	2	3	2	3	2	2	2	2	2	-	2	2	2
AVG	2	2	3	2	3	2	2	2	2	2	-	2	2	2

PEC602	WIRELESS BROADBAND NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the network layer and transport layer protocols for wireless networks
- To understand the architecture and interference mitigation techniques in 3G standards
- To explore the 4G technologies in cellular network.
- To analyse the layer level functionalities in interconnecting networks.
- To assess the emerging techniques in 5G networks.
- To develop the real time applications of 5G networks.

UNIT-I: WIRELESS PROTOCOLS 9

Mobile network layer – Fundamentals of Mobile IP – Data forwarding procedures in mobile IP – IP mobility management, IP addressing- DHCP, Mobile transport layer- Traditional TCP- Congestion control- Slow start, fast recovery/fast retransmission- Classical TCP improvements- Indirect TCP, snooping TCP, Mobile TCP.

UNIT-II: 3G EVOLUTION 9

IMT-2000 - W-CDMA, CDMA 2000- Radio & network components- Network structure- Packet-data transport process flow- Channel Allocation- core network, interference- Mitigation techniques- UMS- Services, air interference – Network architecture of 3GPP- UTRAN architecture- High Speed Packet Data- HSDPA, HSUPA.

UNIT-III: 4G EVOLUTION 9

Introduction to LTE-A – Requirements and Challenges, network architectures- EPC, E- UTRAN architecture- Mobility management, resource management, services, channel- Logical and transport channel mapping- Downlink/uplink data transfer- MAC control element- PDU packet formats- Scheduling services, random access procedure.

UNIT-IV: LAYER-LEVEL FUNCTIONS**9**

Characteristics of wireless channels- Downlink physical layer, uplink physical layer, MAC scheme- Frame structure, resource structure, Mapping- synchronization, reference signals and channel estimation- SC-FDMA, interference cancellation – CoMP, Carrier aggregation.

UNIT-V: 5G EVOLUTION**9**

5G Roadmap - Pillars of 5G - 5G Architecture, The 5G internet - IoT and context awareness - Networking reconfiguration and virtualization support - Mobility QoS control - Emerging approach for resource over provisioning, Small cells for 5G mobile networks- - Mobile data demand, challenges, conclusion and future directions.

TOTAL : 45 Periods**COURSE OUTCOMES:**

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

- Utilize the protocols in wireless networks.
- Understand the architecture of 3G network standards.
- Analyze the difference of LTE-A network design from 4G standard.
- Describe the interconnecting network functionalities by layer level functions.
- Explore the concept of 5G network architecture.
- Assess the performance of 5G networks in real time applications

TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition.
2. Sassan Ahmadi, "LTE-Advanced – A practical systems approach to understanding the 3GPP LTE Releases 10 and 11 radio access technologies", Elsevier, 2014.
3. Jonathan Rodriguez, "Fundamentals of 5G Mobile networks", John Wiley, 2015.

REFERENCES:

1. Vijay K.Garg, "Wireless Network Evolution - 2G & 3G". Prentice Hall, 2008
2. Clint Smith,P.E, Dannel Collins, "3G Wireless Networks" Tata McGraw- Hill, 2nd Edition, 2011.

3. Alexander Kukushkin , “Introduction to Mobile Network Engineering: GSM, 3G-WCDMA, LTE and the Road to 5G”, Wiley, 2018.
4. Erik Dahlman, Stefan Parkvall & Johan Sköld , “4G LTE-Advanced Pro and the Road to 5G”, Academic Press, 2016.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

COs	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC602.1	3	2	2	3	-	-	-	-	-	-	-	3	3	1
PEC602.2	3	3	2	1	-	-	-	-	-	-	-	-	3	2
PEC602.3	3	3	3	3	-	-	-	-	-	-	-	3	3	2
PEC602.4	2	3	3	3	-	-	-	-	-	-	-	3	2	1
PEC602.5	2	2	3	3	-	-	-	-	-	-	-	3	2	2
PEC602.6	3	-	3	3	-	-	-	-	-	-	-	-	2	2
AVG	3	3	3	3	-	-	-	-	-	-	-	3	2	2

PEC603	ADVANCED WIRELESS COMMUNICATION	L	T	P	C
	TECHNIQUES				
		3	0	0	3

OBJECTIVES:

- To learn the concepts of wireless communication.
- To understand the concept of channel models and capacity calculations.
- To interpret the diversity techniques in wireless communication.
- To familiarize the modulation techniques in MIMO communications.
- To explore about multiple user techniques used in the mobile communication.
- To know the concepts of advanced wireless systems.

UNIT-I: WIRELESS CHANNEL MODELS 9

Channel classification- channel models – COST -231 Hata model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, 5G Channel model requirements and Measurements, propagation scenarios, METIS channel models, Map-based model, stochastic model.

UNIT-II: CAPACITY OF WIRELESS CHANNELS 9

Capacity in AWGN, capacity of flat fading channel, capacity of frequency selective fading channels. Capacity of MISO, SIMO systems.

UNIT-III: DIVERSITY 9

Realization of independent fading paths, Receiver Diversity: Selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: CSI known at transmitter, CSI unknown at the transmitter.

UNIT-IV: MULTI USER MIMO COMMUNICATIONS 9

Advances in MIMO wireless communications: Spatial modulation, MIMO based cooperative communication and cognitive radio, multiuser MIMO, cognitive-femtocells and large MIMO systems for 5G wireless.

UNIT-V: MIMO TECHNOLOGY 9

Introduction to MUD, Linear decorrelator, MMSE MUD, Adaptive MUD, MIMO-MUD WCDMA/UMTS- 3GPP-LTE.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the wireless channel characteristics and identify appropriate channel models
- Analyze the capacity calculation under different channel conditions
- Interpret the implication of diversity combining methods and the knowledge of channel
- Describe the modulation techniques in MIMO Communications
- Assess the multi user detection techniques and their use in different multi-user scenarios.
- Apply the concepts of advanced wireless systems in real time applications.

TEXT BOOKS:

1. Andreas.F. Molisch, "Wireless Communications", John Wiley, India, 2011.
2. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2020.
3. Simon Haykins & Michael Moher, "Modern Wireless Communications", Pearson Education, 2007.

REFERENCES:

1. David Tse and Pramod Viswanath, Fundamentals of wireless communications, Cambridge University Press, First Edition, 2012
2. Harry R. Anderson, "Fixed Broadband Wireless System Design", John Wiley, India, 2003.
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
PEC603.1	3	2	3	2	-	-	-	-	-	-	-	3	3	2
PEC603.2	2	3	3	2	-	-	-	-	-	-	-	3	3	3
PEC603.3	3	3	2	2	-	-	-	-	-	-	-	3	2	3
PEC603.4	3	3	3	3	-	-	-	-	-	-	-	3	2	3
PEC603.5	3	3	3	3	-	-	-	-	-	-	-	3	2	2
PEC603.6	3	3	3	2	-	-	-	-	-	-	-	3	2	2
AVG	3	3	3	2	-	-	-	-	-	-	-	3	2	2

COURSE OBJECTIVES:

- To understand the need for SDN and its data plane operations
- To explore the components of SDN.
- To comprehend the migration of networking functions to SDN environment
- To analyze the techniques of network function virtualization
- To assess the characteristics of data center networking
- To develop the solutions for the challenges in the SDN and data center networking.

UNIT I INTRODUCTION**9**

History of Software Defined Networks (SDN) – Modern Data Center – Traditional Switch Architecture – Evolution of SDN – Working of SDN – Centralized and Distributed Control and Data Planes.

UNIT II OPEN FLOW & SDN CONTROLLERS**9**

Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, and SDN via Hypervisor-Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts.

UNIT III SOFTWARE DEFINED NETWORKING**9**

Introduction- Deep Dive (North bound and south bound interface), active network, data and control plane separation abstraction, SDN Open flow prospects and challenges.

UNIT IV NETWORK FUNCTION VIRTUALIZATION**9**

Introduction – NFC concepts, Frame work and Architecture – key challenges – high performance packet processing, comparison of NFC and SDN

UNIT V DATA CENTER NETWORKING**9**

Introduction – characteristics and Challenges – protocols innovation – network telemetry- server less computing, content distribution in IP networks- Information centric networking

TOTAL: 45 Periods**COURSE OUTCOMES**

On Completion of the course the students will be able to

- Understand the need for SDN and its data plane operations
- Explore the components of SDN.
- Illustrate the migration of networking functions to SDN environment
- Analyze the techniques of network function virtualization
- Assess the characteristics of data center networking.

- Develop the solutions for the challenges in the SDN and data center networking.

TEXTBOOKS:

1. William Stallings, “Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud”, Pearson Education, 1st Edition, 2015.

REFERENCES:

1. Information-Centric Networking (ICN): Content Centric Networking (CCNx) and Named Data Networking (NDN) Terminology, B. Wissingh, C. Wood, A. Afanasyev, L. Zhang, D. Oran and C. Tschudin, RFC 8793, June 2020
2. Chayapathi R, Hassan SF, Shah P. Network Functions Virtualization (NFV) with a Touch of SDN: Netw Fun Vir (NFV ePub_1. Addison- Wesley Professional; 2016
3. Marschke D, Doyle J, Moyer P. Software Defined Networking (SDN): Anatomy of OpenFlow Volume 1. 2015.
4. Information-Centric Networks: A New Paradigm for the Internet (Focus Series in Networks and Telecommunications), Gabriel M. de Brito, Pedro B. Velloso, Igor M. Moraes, WileyISTE; 1st edition, 2013, ISBN: 9781848214491

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC604. 1	1	2	3	1	-	-	-	-	-	-	-	3	1	2
PEC604. 2	2	1	2	2	-	-	-	-	-	-	-	2	1	3
PEC604. 3	2	2	2	3	-	-	-	-	-	-	-	2	1	3
PEC604. 4	2	2	2	3	-	-	-	-	-	-	-	2	1	2
PEC604. 5	2	3	1	3	-	-	-	-	-	-	-	2	2	2
PEC604. 6	3	2	3	1	-	-	-	-	-	-	-	2	2	2
AVG	2	2	2	2	-	-	-	-	-	-	-	2	1	2

OBJECTIVES:

- To learn the evolution of wireless networks.
- To get acquainted with the fundamentals of 5G networks.
- To study the processes associated with 5G architecture.
- To study spectrum sharing and spectrum trading.
- To learn the security features in 5G networks.
- To explore emerging technologies in 6G wireless networks.

UNIT-I: EVOLUTION OF WIRELESS NETWORKS 9

Network evolution: 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: LINEAR PREDICTION AND FILTERING 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 – 5G protocols: NAS, NGAP, GTP-U, IPsec and GRE.

UNIT-IV: DYNAMIC SPECTRUM MANAGEMENT AND SECURITY IN 5G NETWORKS 9

Mobility management- Command and control- Spectrum sharing and spectrum trading- Security features in 5G networks- Network domain security- User domain security- Flow based QoS framework – Mitigating- The threats in 5G.

Evolution from 5G to 6G: Motivation and vision -Terahertz (THz) communication: Spectrum, challenges, hardware - Visible Light Communication (VLC) and Optical Wireless Communication- Reconfigurable Intelligent Surfaces (RIS) - Quantum Communication.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- To understand the evolution of wireless networks.
- To learn the concepts of 5G networks.
- To comprehend the 5G architecture and protocols.
- To understand the dynamic spectrum management.
- To learn the security aspects in 5G networks.
- To explore emerging technologies in 6G wireless networks

TEXT BOOKS:

1. 5G Core networks: Powering Digitalization, Stephen Rommer, Academic Press,2019.
2. An Introduction to 5G Wireless Networks: Technology, Concepts and Use cases, Saro Velrajan,First Edition, 2020.
3. 6G Mobile Wireless Networks: Enabling Technologies, Architectures, and Challenges – Yulei Wu, Houbing Song, et al., Springer,March 2021.

REFERENCES:

1. 5G Simplified: ABCs of Advanced Mobile Communications Jyrki. T.J.Penttinen,Copyrighted Material.
2. 5G system Design: An end to end Perspective, Wan Lee Anthony, Springer Publications, 2019.

3. Vyas,A. K.,Khatri, N., & Jha, S. K. (2021).6G Communication Network: Architecture, Security and Applications. CRC Press (Taylor & Francis).ISBN: 9780367702464

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	1
PEC605.1	3	3	3	3	2	-	-	-	-	-	-	-	1	1
PEC605.2	3	3	3	2	2	-	-	-	-	-	-	-	1	1
PEC605.3	3	3	3	3	2	-	-	-	-	-	-	-	2	2
PEC605.4	3	3	3	3	2	-	-	-	-	-	-	-	3	3
PEC605.5	3	2	3	3	2	-	-	-	-	-	-	-	2	2
PEC605.6	3	3	3	2	3	-	-	-	-	-	-	-	2	2
AVG	3	3	3	3	2	-	-	-	-	-	-	-	2	2

OBJECTIVES:

- To understand the massive MIMO networks.
- To learn the concept of massive MIMO propagation channel.
- To estimate the capacity of massive MIMO channel.
- To find the channel estimation techniques for single cell system.
- To analyze the channel estimation techniques for single cell system.
- To apply the concept of single and multicell massive MIMO systems.

UNIT-I: MASSIVE MIMO NETWORKS 9

Definition of Massive MIMO, Correlated Rayleigh Fading, System Model for Uplink and Downlink, Basic Impact of Spatial Channel Correlation, Channel Hardening and Desirable propagation techniques, Local Scattering Spatial Correlation Model

UNIT-II: MASSIVE MIMO PROPAGATION CHANNEL 9

Deterministic Channels- Upper Bound Capacity - Linear Processing- Singular Values - Random Channels- Independent Rayleigh Fading- Uniformly Random Line-of-Sight (UR-LoS) - Finite Dimensional Channels

UNIT-III: SINGLE-CELL SYSTEMS 9

Introduction to Single cell systems - Channel Estimation – Precoding techniques – Channel state information - Orthogonal Pilots- De-Spreading of the Received Pilot Signal - Interpretation of the Effective SINR Expressions - Limiting Factors: Number of Antennas and Mobility.

UNIT-IV: MULTI-CELL SYSTEMS 9

Introduction to Multi cell systems – Comparison between Single cell and Multi-cell systems - Downlink Data Transmission -Zero-Forcing – Maximum-Ratio, Asymptotic Limits with Infinite Numbers of Base Station Antennas – The Effects of Pilot Contamination – Non-Synchronous Pilot Interference – performance evaluation.

UNIT-V: CASE STUDIES**9**

Single-Cell Deployment Example: Fixed Broadband Access in Rural Area, Multi-Cell Deployment: Preliminaries and Algorithms, Multi-Cell Deployment Examples: Mobile Access – Dense Urban Scenario – Suburban Scenario – Minimum Per-Terminal Throughput Performance -Additional Observations – Comparison of Power Control Policies

TOTAL : 45 Periods**COURSE OUTCOMES:**

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

- Understand and explain massive MIMO networks.
- Learn about massive MIMO propagation channels.
- Describe the capacity bounds of massive MIMO channels.
- Examine channel estimation techniques for single cell system.
- Explore the channel estimation techniques for multi cell system.
- Analyze the concepts underlining the deployment of single and multicell massive MIMO systems.

TEXT BOOKS:

1. Thomas L. Marzetta, Erik G. Larsson, Hong Yang, Hien Quoc Ngo, “Fundamentals of Massive MIMO”, Cambridge University Press 2016. (UNITS II-V)
2. Emil Bjornson, Jakob Hoydis and Luca Sanguinetti (2017), “Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency”, Foundations and Trends, Now, 2017.

REFERENCES:

1. Long Zhao, Hui Zhao, Kan Zheng, “Wei Xiang Massive MIMO in 5G Networks: Selected Applications”, Springer 2018.
2. Leibo Liu, Guiqiang Peng, Shaojun Wei, “Massive MIMO Detection Algorithm and VLSI Architecture”, Springer 2019.

3. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai, “mmWave Massive MIMO A Paradigm for 5G”, Elsevier, 2017.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
PEC606.1	3	3	2	-	-	-	-	-	-	-	-	2	2	2
PEC606.2	2	3	3	-	-	-	-	-	-	-	-	2	2	2
PEC606.3	2	3	3	-	-	-	-	-	-	-	-	2	2	2
PEC606.4	2	3	3	-	-	-	-	-	-	-	-	2	2	2
PEC606.5	1	3	3	-	-	-	-	-	-	-	-	2	2	2
PEC606.6	2	3	3	2	-	-	-	-	-	-	-	2	2	2
AVG	2	3	3	2	-	-	-	-	-	-	-	2	2	2

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 Protection 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 LEISA 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 the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989.
4. Sithampanathan, 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
CO	2	2	-	-	-	1	1	-	-	1	-	-	2	2	1	1
CO	2	3	1	-	2	3	-	-	1	-	1	1	1	1	1	2
CO	1	3	-	-	-	1	2	-	-	-	-	2	2	2	2	1
CO	3	3	3	2	3	-	3	2	1	-	2	3	2	1	1	-
CO	-	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

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, Rhizobium, 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, 9
BRANDING, PACKAGING AND MARKETING OF ORGANIC
PRODUCTS

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 Soyong, 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.

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	L	T	P	C
	ENGINEERING	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

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

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

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 Madiseti, 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

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, complete link, group-average similarity- k-Means and Mixtures of Gaussians-Flat clustering-k-Means algorithms-Mixture of Gaussian model EM-algorithm for mixture of Gaussian model. Case Study: 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 basic 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

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: COMPUTATIONAL LINGUISTICS**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: TAMIL COMPUTING APPLICATIONS**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	1.6	2										

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

Discovery of Electronic Evidence- Identification of Data – Reconstructing Past Events – Fighting against Macro Threats – Information Warfare Arsenal – Tactics of the Military – 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”, Cengage Learning, 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 Digital Crime”, 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	-

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 POLICIES 9

Reputation Strategies-Brand Impact-Crisis Management-Corporate Communication-Social Media 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 Manage Your 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" by Christopher 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	-

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			

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.

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		

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

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 right process 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, anemometers, 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 counter (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

OBJECTIVES:**The student should be made to:**

- To learn about the shelf life of food products.
- To gain knowledge on the storage of food products.
- To know about the thermal and non-thermal processing methods of food.
- To design different types of Dryers and methods to prevent food wastage.
- To understand the Food Hygiene methods and its importance.

UNIT – I: FOOD PROCESSING AND ITS IMPORTANCE 9

Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

UNIT – II: METHODS OF FOOD HANDLING AND STORAGE 9

Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods. Retort pouch packing, Aseptic packaging.

UNIT – III: THERMAL METHODS AND NON-THERMAL METHODS 9

Newer methods of thermal processing- batch and continuous - In container sterilization canning - application of infra-red microwaves - ohmic heating - control of water activity - preservation by concentration and dehydration - osmotic methods. Super Critical Technology for Preservation - Chemical preservatives, preservation by ionizing radiations, ultrasonics, high pressure, fermentation, curing, pickling, smoking, membrane technology. Hurdle technology.

UNIT – IV: DRYING PROCESS FOR TYPICAL FOODS & FOOD WASTES IN VARIOUS PROCESSES 9

Rate of drying for food products; design parameters of different type of dryers; properties of air-water mixtures. Psychometric chart, freezing and cold storage, freeze concentration, dehydro-freezing, freeze drying, IQF; calculation of refrigeration load, design of freezers and

cold storages. Waste disposal-solid and liquid waste, rodent and insect control, use of pesticides, ETP, selecting and installing necessary equipment.

UNIT – V: FOOD HYGIENE

9

Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training & Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.

TOTAL PERIODS:45

COURSE OUTCOMES:

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

CO1: Aware of the different methods applied to preserving foods.

CO2: Explain the food handling and storage processes.

CO3: Analyze the thermal and non-thermal processing methods.

CO4: Explore the drying process of foods.

CO5: Understand Food Hazards, Adulteration, and Safety in handling and procurement & Microbial considerations and sanitation.

TEXT BOOKS:

1. Karnal, Marcus and D.B. Lund “Physical Principles of Food Preservation”.Rutledge, 2003.
2. VanGarde, S.J. and Woodburn. M “Food Preservation and Safety Principles and Practice”.Surbhi Publications, 2001.
3. Sivasankar, B. “Food Processing & Preservation”, Prentice Hall of India, 2002.
4. Khetarpaul, Neelam, “Food Processing and Preservation”, Daya Publications, 2005.

REFERENCE BOOKS:

1. Shafiur M Rahman, “Handbook of Food Preservation”, Second Edition, CRC Press, 2007
2. Zeuthen Peter, Bogh-Sorensen Leif, “Food Preservation Techniques”, Wood Head

Publishing, Cambridge, England, 2005.

- Ranganna S, "Handbook of Canning and Aseptic Packaging", Tata McGraw-Hill, 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	2	-	-	3	-	1	1	-	-	-	-	-	-	1
CO2	2	3	1	2	-	-	-	2	-	-	-	2	-	1
CO3	3	2	1	2	-	1	1	-	-	-	-	2	-	1
CO4	3	2	1	2	-	1	1	-	-	-	-	2	-	1
CO5	3	1	2	-	-	1	1	-	-	-	-	2	-	1
Average	3	2	1.3	2.3	-	1	1	2	-	-	-	2	-	1

OBJECTIVES:

- To explore the characteristics of electrode configuration.
- To study the characteristics of Bio signals.
- To explain the necessity of bio amplifiers in biomedical signal processing.
- To analyze the different techniques used for measurement of non-electrical bio-parameters.
- To understand the biochemical measurement techniques and sensors.

UNIT – I: ELECTRODE CONFIGURATIONS**9**

Origin of bio potential and its propagation. Frequency and amplitude ranges. Electrode configurations: Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non- polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes.

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: MEASUREMENT OF BIO SIGNALS**9**

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, oscillometric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit. Blood flow and cardiac output measurement: Indicator dilution, thermal dilution and dye dilution method, Electromagnetic and ultrasound blood flow measurements

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.

TOTAL PERIODS: 45**COURSE OUTCOMES:**

CO1: Illustrate the origin of various biological signals and their characteristics.

CO2: Apply knowledge of bio signal characteristics.

CO3: Gain knowledge on various amplifiers involved in monitoring bio signals.

CO4: Identify appropriate instruments and methods for each physiological parameter.

CO5: Examine the biochemical measurement techniques.

TEXT BOOKS:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", 2nd edition, Prentice hall of India, New Delhi, 2015.
2. John G. Webster, "Medical Instrumentation Application and Design", 4th edition, Wiley India Pvt Ltd, New Delhi, 2015.
3. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003.

REFERENCE BOOKS:

1. John Enderle, Susan Blanchard, Joseph Bronzino, "Introduction to Biomedical Engineering", second edition, Academic Press, 2005.
2. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, 2004.

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

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

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

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

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	-

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	-	-	-	-

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 Python 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.	-	-	-	-	-	-	-	-	-	-	-

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. Serop 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 spheroidizing 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, carbonitriding, 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. To 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-I 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 Charles A. Wentz. Second edition 1995. McGraw Hill International.
2. Hazardous waste management Michael D. La Gerga, Philip L 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 & Samuel 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)

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 automatic transmission – antilock braking system – electronic suspension system – working of air bag and role of MEMS in airbag systems – centralized door locking system – climate control of 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)

(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.

- Azamal Husen, Khwaja Salahuddin Siddiqi, “Advances in Smart Nanomaterials and their Applications (Micro and Nano Technologies)”, 1st Edition, Elsevier, Netherlands, 2023.

REFERENCES

- William A Goddard “Handbook of Nanoscience, Engineering and Technology”, 3rd Edition, CRC Taylor and Francis, United Kingdom, 2012.
- G. Cao, “Nanostructures & Nanomaterials: Synthesis, Properties & Applications”, Imperial College Press, London, 2004.
- N. Kumar, “Concise concepts of nanoscience and nanomaterials”, Scientific publishers, New Delhi, 2019.
- 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.
- 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

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 acutation. 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

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 Misra Financial Management, Oxford University Press, 2011.
5. Parasuraman, N.R Financial Management: a step-by-step approach, 2nd edition; Cengage Learning India Pvt. Ltd., 2019.

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.

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.

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.

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., Barberis 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 ENTREPRENEURSHIP

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 & ENVIRONMENT

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 ENTREPRENEURSHIP

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 opportunities 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.

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 - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - 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.

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.

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 and Macro
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 DISTRIBUTION 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.

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

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 Hill 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.

VERTICAL 3: PUBLIC ADMINISTRATION

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 Administration 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 public perspective.
4. To study and explore the approaches of administrative process.
5. To cover the principles, practices and the impact of public administration on society.

UNIT I INTRODUCTION TO PUBLIC ADMINISTRATION 9

Meaning- Nature and Scope of Public Administration, Evolution of Public Administration, Public Administration and Private Administration, Public Administration –Arts, Science or 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 Governance.

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 Management Approach, Bureaucratic Approach, Human Relations Approach, Ecological Approach.

UNIT V PRINCIPLES AND PRACTICES OF PUBLIC ADMINISTRATION 9

Chief Executive - Meaning, Types, Functions & Qualities of Chief Executive, 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 Management, Politics, and Law in the Public Sector, McGraw Hill, 2018.
3. Avasthi and Maheswari: Public Administration in India, Agra:Lakshmi Narain Agarwal,2013.
4. Ramesh K Arora: Indian Public Administration, New Delhi: Wishwa Prakashan, 2012.
5. R.B. Jain: Public Administration in India,21st Century Challenges for Good Governance, New Delhi: Deep and Deep, 2002.

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 Assembly – Role. 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.

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. Cogburn 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

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

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

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.

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. Ramesh and 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.

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. 2025.

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.

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 transshipments, 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.

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.

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

Soil 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	-

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 Composite(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 NANOBIMATERIALS 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. Leopoldo 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	-	-	-	-	-	-	-	-	-	-	-

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)Se₂ solar cells – Cadmium 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 - benzene – 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, Pushendra 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

manufacturing, design and implementation of sustainable green production systems.

UNIT- V GREEN NANOTECHNOLOGY

9

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 convection 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 solid 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