

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)
SRM Nagar, Kattankulathur-603203.

(Approved by AICTE, Affiliated to Anna University)

Electrical and Electronics Engineering



UG-Curricula and Syllabi

B.E. – Electrical and Electronics Engineering

Regulation 2023

SRM VALLIAMMAI ENGINEERING COLLEGE

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

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING REGULATIONS – 2023

1. 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.

2. MISSION OF THE INSTITUTE:

M1: 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.

M2: To build the institution with international reputation in education in several areas at several levels with specific emphasis to promote higher education and research through strong institute-industry interaction and consultancy.

3. VISION OF THE DEPARTMENT:

To accomplish and maintain international eminence and to contribute to become a model institution for higher learning through development of highly competent and dynamic Electrical and Electronics Engineers while remaining sensitive to ethical, societal and environmental issues.

4. MISSION OF THE DEPARTMENT:

1. To mould Electrical and Electronics Engineers and Entrepreneurs of international excellence as global leaders capable of contributing towards technological innovations, economic growth and environmental safety.

2. To transform the Department into centre of excellence in the domain of Electrical and Electronics engineering by promoting research and development, consultancy work and industry- institute interaction activities.

5. PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

1. To prepare the students have successful careers in industry, Entrepreneur, Leadership, Communication skill and motivate for higher education.
2. To provide students with adequate technical knowledge and skills in using modern engineering tools to apply mathematics, science and engineering fundamentals to the modelling, analysis and solution of problems related to electrical and electronics engineering.
3. To provide an opportunity to work in interdisciplinary groups.
4. To promote student awareness for life-long learning and inculcate professional ethics.
5. To provide necessary foundation on computational platforms and software applications related to electrical engineering.

6. PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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 the public health and safety, and the 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 modeling 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 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.

7. PROGRAM SPECIFIC OUTCOMES (PSOs):

Electrical and Electronics Engineering Graduates will be able to:

1. Apply the knowledge of electrical science, circuit theory, electronics, instrumentation, digital systems, electromagnetic fields, and control theory to analyze and solve complex electrical and electronics engineering problems.
2. Model, design, and analyze various components of power systems to ensure reliable and efficient operation.
3. Apply the knowledge of power electronic devices and converters for efficient control and operation of electrical drives and power systems.
4. Understand and apply the concepts of microcontrollers, embedded systems, discrete-time systems, and signal processing in electrical and electronic applications.

8. PEO / PO & PSO MAPPING

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

Contribution 1 - Reasonable 2 - Significant 3 - Strong

MAPPING – UG- ELECTRICAL AND ELECTRONICS ENGINEERING

Year	Sem	Subject code & Name	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
I	I	EN3111 - Professional English – I	2.2	2.7	2	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-
		MA3122 - Matrices and Calculus	3.0	2.0	2.0	1.0	-	-	-	-	-	-	-	1.0	-	-	-	-
		PH3123 - Engineering Physics	2.8	1.4	1.4	1.0	1.3	1.0	1.0	-	-	-	-	1.0	-	-	-	-
		CH3124 - Engineering Chemistry	2.8	1.8	2.2	1.5	1.0	1.0	2.0	-	-	-	-	2.0	-	-	-	-
		GE3133 - Basic Civil and Mechanical Engineering	3.0	1.8	2.0	1	-	1.5	1.5	1	-	-	-	1	-	-	-	-
		GE3111 - தகழிர் மரய் / Heritage of Tamils													-	-	-	-
		EN3119 - English Language Learning Laboratory	1.7	1.3	1	1.3	2	-	2	-	-	2.8	-	1	-	-	-	-
		GE3121 - Physics and Chemistry Laboratory	3.0	2.4	2.6	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-
			2.0	1.0	0.8	1.0	1.2	-	1.0	-	-	-	-	1.0	-	-	-	-
		GE3134 - Engineering Practices Laboratory	3.0	2.0	2.3	2.0	2.3	1.0	-	-	1.0	-	1.0	1.0	-	-	-	-
I	II	EN3211 - Professional English – II	2.0	2.0	1.4	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-
		MA3222 - Statistics and Numerical Methods	3.0	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		PH3223 - Physics for Electronics Engineering (common to ECE,EIE)	3.0	1.7	1.5	1.0	2.0	1.5	3.0	-	-	-	-	1.0	-	-	-	-
		CH3223 - Chemistry of Electronic Materials (common to ECE,EIE)	2.6	2.4	2.2	1.8	1.7	1.0	1.0	-	-	-	-	2.0	-	-	-	-
		GE3231 - Problem Solving and Python Programming	2.4	2.6	3.0	2.8	1.8	-	-	-	-	-	1.6	2.0	-	-	-	-
		GE3211 - தகழி ம் டெதாரல் ட்ப ம் / Tamils and Technology																
		GE3233 - Engineering Graphics and Design	3.0	1.0	2.0	-	2.0	-	-	-	-	3.0	-	2.0	-	-	-	-
		GE3221 - Engineering Sciences Laboratory	3.0	2.4	2.6	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-
			2.0	1.4	1.0	1.0	1.2	2.0	1.5	2.0					-	-	-	-
		GE3232 – Problem Solving and Python Programming Laboratory	2.6	2.6	3.0	2.8	2.2	-	-	-	-	-	2.0	2.0	-	-	-	-
		GE3251 - NSS / YRC / NSO / Club Activities #																

Year	Sem		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
II	III																	
		MA3321 - Transforms and Partial Differential Equations	3.0	3.0	-	-	1.0	-	-	-	-	-	-	1.0	-	-	-	-
		EC3365 - Electromagnetic Fields	3.0	2.0	1.0	2.0	-	-	-	-	-	-	-	2.0	2.0	1.0	-	-
		EE3361 - Digital Logic Circuits	3.0	3.0	3.0	1.0	3.0	-	-	-	-	-	-	1.0	3.0	-	1.0	-
		EE3362 - Electrical Machines – I	3.0	3.0	1.0	1.0	1.0	-	-	-	-	-	-	-	2.0	2.0	-	-
		EE3363 - Electric Circuit Analysis	3.0	3.0	1.0	1.0	1.0	-	-	-	-	-	-	-	2.0	2.0	-	-
		EI3361 - Electron Devices and Circuits	2.6	2.6	2.2	2.0	-	-	-	1.0		1.0	-	-	1.2	-	-	2.0
		EE3364 - Electrical Machines Laboratory – I	3.0	3.0	2.0	1.3	-	-	-	-	-	-	-	1.2	2.0	2.0	-	-
		EE3365 - Electric Circuits Laboratory	1.0	1.0	1.0	1.0	1.0	-	2.5	2.0	3.0	-	2.0	3.0	1.0	2.3	2.0	3.0
		EI3365 - Electron Devices and Circuits Laboratory	3.0	2.0	1.0	-	-	2.0	-	2.0	2.0	1.0	-	-	-	-	-	1.4
II	IV	MA3423 - Applied Mathematics for Electrical and Instrumentation Engineering	3.0	1.6	1.4	1.0	-	-	-	-	-	-	-	1.0	-	-	-	-
		EC3462 - Linear Integrated Circuits	2.8	2.2	2.6	2.4	2.6	1.6	-	-	-	-	1.0	1.4	2.0	1.0	1.0	1.0
		EI3464 - Control Systems	2.8	2.6	2.8	2.2	-	-	-	2.8	-	2.8	-	1	1.4	-	-	1.8
		EE3461 - Electrical Machines - II	3.0	3.0	1.0	1.0	1.0	-	-	-	-	-	-	-	3.0	3.0	-	-
		EE3462 - Transmission and Distribution	3.0	3.0	2.0	3.0	-	-	1.0	-	-	-	-	2.0	3.0	3.0	-	-
		EE3463 - Measurements and Instrumentation	3.0	2.0	3.0	2.0	3.0	2.0	-	2.0	-	3.0	-	3.0	3.0	3.0	3.0	-
		GE3451 - NCC Credit Course Level - I																
		EE3464 - Electrical Machines Laboratory – II	3.0	3.0	2.0	1.3	-	-	-	-	-	-	-	1.2	2.0	2.0	-	-
		EE3465 - Measurements and Instrumentation Laboratory	3.0	3.0	2.0	1.3	-	-	-	-	-	-	-	1.2	2.0	2.0	-	-
		EI3469 - Control Systems Laboratory	3.0	3.0	3.0	3.0	3.0	-	-	2.0	-	-	-	2.0	3.0	3.0	3.0	3.0

Year III	Sem V		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
		EE3561- Power System Analysis	3	3	1	1	1	-	1.2	-	-	-	-	2	3	3	-	-
		EE3562- Power Electronics	3	3	3	3	-	-	1.5	1	-	-	2	3	-	1	1	-
		EE3563- Protection and Switchgear	2.6	2	1.8	1.8	2.2	1.8	1	1	1	1	1	1	1.8	1.8	1	1
		IT3563- C Programming and Data Structures	1.6	2.2	1	1.8	2	1	1	-	1.2	1.4	1	2.4	-	-	-	-
		PEIXXX - Professional Elective-I																
		PEIXXX - Professional Elective-II																
		CE3531- Environmental Studies	2.8	1.8	1.0	1.0	-	2.2	2.4	-	-	-	-	1.8	-	-	-	-
		GE3551 - NCC Credit Course Level-II																
		EE3564 - Power Electronics Laboratory	3	3	3	3	-	-	-	1	-	-	-	3	-	1	1	-
		EE3565 - Linear and Digital Integrated Circuits Laboratory	3	3	3	3	-	-	-	1	-	-	-	3	-	1	1	-
		IT3564- C Programming and Data Structures Laboratory	1.6	2.2	1	1.8	2	1	1	-	1.2	1.4	1	2.4	-	-	-	-
Year III	Sem VI	EE3661 - Power System Operation and Control	1.6	2	1.8	1.8	2.5	3	1	-	-	-	1	-	1.3	1.8	1	1
		EE3662 - Solid State Drives	2.4	2.4	2	1.5	2	1	-	1	3	2	-	1	2.4	2.5	2	1
		EE3663 - Microprocessors and Microcontrollers	2.2	2.2	1.8	1.8	2.4	-	2	-	2	-	2	1.5	-	-	-	-
		PEIXXX - Professional Elective-III																
		PEIXXX - Professional Elective-IV																
		MAN10X-Management Elective																
		MXXXXXX - Mandatory Course-I																
		EE3664 - Microprocessors and Microcontrollers Laboratory	2	1	2	3	-	-	-	1.5	-	-	-	3	-	-	-	-
		EE3641 - Mini Project	3	1.6	3	3	2	-	1	2	2	3	3	3	2.6	2.4	2	1.4
		EN3649 - Professional Communication Laboratory	1.0	1.0	-	1.0	1.0	1	-	-	-	2	-	1.0	-	-	-	-

Year IV	Sem VII		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
		EE3761 - High Voltage Engineering	2.4	1.4	2	1.8	2.4	1	1	3	1	1	1	1	2.5	1.7	1	2
		EE3762 - Renewable Energy systems	1.8	1.5	3	2	1.5	3	2	2.3	3	1	2	1.5	3	2.5	1	
		PEIXXX - Professional Elective-V																
		PEIXXX - Professional Elective-VI																
		BA3711 - Human Values and Ethics	-	-	1	1.5	-	-	1	-	-	-	-	-	-	-	-	-
		OXXXXX - Open Elective *																
		MXXXXX - Mandatory Course-II																
		EE3763 - Power System Simulation Laboratory	1	1.7	1.5	1.5	1.5	2.5	1	1		1.5	1.5	1	2.5	1	3	1
		EE3764 - Renewable Energy Systems Laboratory	1.5	2.5	1.5	2	2	3	3	1.5	1	1	3	2	1	2.3	2.5	3
		EE3741 - Internship	2.8	3	3	3	2.6	2.7	2.7	2	2.5	2.4	2.8	2.6	2.8	3	3	2.5
Year IV	Sem VIII	EE3841 - Project Work	2.8	2.6	3	3	2.6	3	2.7	2	2.6	2.4	2.8	2.6	2.8	3	3	2.5

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ELECTRICAL AND ELECTRONICS ENGINEERING**CHOICE BASED CREDIT SYSTEM****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	GE3133	Basic Civil and Mechanical 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	தமிழ் மொத்தார்பல் டீப ம் / 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	EC3365	Electromagnetic Fields	PCC	3	0	0	3	3
3	EE3361	Digital Logic Circuits	PCC	3	0	0	3	3
4	EE3362	Electrical Machines - I	PCC	3	0	0	3	3
5	EE3363	Electric Circuit Analysis	PCC	3	0	0	3	3
6	EI3361	Electron Devices and Circuits	PCC	3	0	0	3	3
PRACTICAL								
7	EE3364	Electrical Machines Laboratory - I	PCC	0	0	3	3	1.5
8	EE3365	Electric Circuits Laboratory	PCC	0	0	3	3	1.5
9	EI3365	Electron Devices and Circuits Laboratory	PCC	0	0	3	3	1.5
Total				18	18	9	9	22.5

Semester - IV								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	MA3423	Applied Mathematics for Electrical and Instrumentation Engineering	BSC	2	0	0	2	2
2	EC3462	Linear Integrated Circuits	PCC	3	0	0	3	3
3	EI3464	Control Systems	PCC	3	0	0	3	3
4	EE3461	Electrical Machines - II	PCC	3	0	0	3	3
5	EE3462	Transmission and Distribution	PCC	3	0	0	3	3
6	EE3463	Measurements and Instrumentation	PCC	3	0	0	3	3
7	GE3451	NCC Credit Course Level - I*	PCD	3	0	0	3	3
PRACTICAL								
8	EE3464	Electrical Machines Laboratory - II	PCC	0	0	3	3	1.5
9	EE3465	Measurements and Instrumentation Laboratory	PCC	0	0	3	3	1.5
10	EI3469	Control Systems Laboratory	PCC	0	0	3	3	1.5
Total				17	0	9	26	21.5

* 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	EE3561	Power System Analysis	PCC	3	0	0	3	3
2	EE3562	Power Electronics	PCC	3	0	0	3	3
3	EE3563	Protection and Switchgear	PCC	3	0	0	3	3
4	IT3563	C Programming and Data Structures	PCC	3	0	0	3	3
5	PEE10X	Professional Elective-I	PEC	3	0	0	3	3
6	PEE20X	Professional Elective-II	PEC	3	0	0	3	3
7	CE3531	Environmental Studies	ESC	2	0	0	2	2
8	GE3551	NCC Credit Course Level-II #	PCD	3	0	0	3	3
PRACTICAL								
9	EE3564	Power Electronics Laboratory	PCC	0	0	3	3	1.5
10	EE3565	Linear and Digital Integrated Circuits Laboratory	PCC	0	0	3	3	1.5
11	IT3564	C Programming and Data Structures Laboratory	PCC	0	0	3	3	1.5
Total				20	0	9	29	24.5

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	EE3661	Power System Operation and Control	PCC	3	0	0	3	3
2	EE3662	Solid State Drives	PCC	3	0	0	3	3
3	EE3663	Microprocessors and Microcontrollers	PCC	3	0	0	3	3
4	PEE30X	Professional Elective-III	PEC	3	0	0	3	3
5	PEE40X	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	EE3664	Microprocessors and Microcontrollers Laboratory	PCC	0	0	3	3	1.5
9	EE3641	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	EE3761	High Voltage Engineering	PCC	3	0	0	3	3
2	EE3762	Renewable Energy systems	PCC	3	0	0	3	3
3	PEI50X	Professional Elective-V	PEC	3	0	0	3	3
4	PEE60X	Professional Elective-VI	PEC	3	0	0	3	3
5	BA3711	Human Values and Ethics	HSMC	2	0	0	2	2
6	OXXXXX	Open Elective *	OEC	3	0	0	3	3
7	MXX20X	Mandatory Course-II	MC	3	0	0	3	0
PRACTICAL								
8	EE3763	Power System Simulation Laboratory	PCC	0	0	3	3	1.5
9	EE3764	Renewable Energy systems Laboratory	PCC	0	0	3	3	1.5
10	EE3741	Internship	EEC	0	0	0	0	1
Total				20	0	6	26	21

* 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	EE3841	Project Work	EEC	0	0	20	20	10
Total				0	0	20	20	10

Total Credits: 167

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

PROFESSIONAL ELECTIVE COURSES: VERTICALS						
PE	Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V	Vertical VI
	Power Engineering	Converters and Drives	Embedded Systems	Electric Vehicle Technology	Advanced Control	Renewable Energy Technology
1	Utilization and Conservation of Electrical Energy	Special Electrical Machines	Embedded System Design	Electric Vehicle Architecture	Process Modeling and Simulation	Energy Storage Systems
2	Under Ground Cable Engineering	Analysis of Electrical Machines	Embedded C-Programming	Design of Motor and Power Converters for Electric Vehicles	Advanced Process Control	Hybrid Energy Technology
3	Substation Engineering and Automation	Multilevel Power Converters	Embedded Processors	Electric Vehicle Design, Mechanics and Control	Model Based Control	Design and Modelling of Renewable Energy Systems
4	HVDC and FACTS	Electrical Drives	Embedded Control for Electrical Drives	Design of Electric Vehicle Charging System	System Identification and Adaptive Control	Grid integrating Techniques and Challenges
5	Energy Management and Auditing	SMPS and UPS	Smart System Automation	Testing of Electric Vehicles	Non Linear Control	Wind Energy Conversion Systems
6	Power Quality	Power Electronics for Renewable Energy Systems	Embedded System for Automotive Applications.	Grid Integration of Electric Vehicles	Optimal Control	Solar and Wind Energy Engineering

Registration of Professional Elective Courses from Verticals: Professional Elective Courses will be registered in Semesters V and VI. 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: POWER ENGINEERING								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEE101	Utilization and Conservation of Electrical Energy	PEC	3	0	0	3	3
2	PEE102	Under Ground Cable Engineering	PEC	3	0	0	3	3
3	PEE103	Substation Engineering and Automation	PEC	3	0	0	3	3
4	PEE104	HVDC and FACTS	PEC	3	0	0	3	3
5	PEE105	Energy Management and Auditing	PEC	3	0	0	3	3
6	PEE106	Power Quality	PEC	3	0	0	3	3

VERTICAL-II: CONVERTERS AND DRIVES								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEE201	Special Electrical Machines	PEC	3	0	0	3	3
2	PEE202	Analysis of Electrical Machines	PEC	3	0	0	3	3
3	PEE203	Multilevel Power Converters	PEC	3	0	0	3	3
4	PEE204	Electrical Drives	PEC	3	0	0	3	3
5	PEE205	SMPS and UPS	PEC	3	0	0	3	3
6	PEE206	Power Electronics for Renewable Energy Systems	PEC	3	0	0	3	3

VERTICAL-III: EMBEDDED SYSTEMS								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEE301	Embedded System Design	PEC	3	0	0	3	3
2	PEE302	Embedded C- programming	PEC	3	0	0	3	3
3	PEE303	Embedded Processors	PEC	3	0	0	3	3
4	PEE304	Embedded Control for Electric Drives	PEC	3	0	0	3	3
5	PEE305	Smart System Automation	PEC	3	0	0	3	3
6	PEE306	Embedded System for Automotive Applications	PEC	3	0	0	3	3

VERTICAL-IV: ELECTRIC VEHICLE TECHNOLOGY								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEE401	Electric Vehicle Architecture	PEC	3	0	0	3	3
2	PEE402	Design of Motor and Power Converters for Electric Vehicles	PEC	3	0	0	3	3
3	PEE403	Electric Vehicle Design, Mechanics and Control	PEC	3	0	0	3	3
4	PEE404	Design of Electric Vehicle Charging System	PEC	3	0	0	3	3
5	PEE405	Testing of Electrical Vehicles	PEC	3	0	0	3	3
6	PEE406	Grid Integration of Electric Vehicles	PEC	3	0	0	3	3

VERTICAL-V: ADVANCED CONTROL								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEI201	Process Modeling and Simulation	PEC	3	0	0	3	3
2	PEI202	Advanced Process Control	PEC	3	0	0	3	3
3	PEI203	Model Based Control	PEC	3	0	0	3	3
4	PEI204	System Identification and Adaptive Control	PEC	3	0	0	3	3
5	PEI205	Non Linear Control	PEC	3	0	0	3	3
6	PEI206	Optimal Control	PEC	3	0	0	3	3

VERTICAL-VI: GREEN RENEWABLE ENERGY								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
THEORY								
1	PEE601	Energy Storage Systems	PEC	3	0	0	3	3
2	PEE602	Hybrid Energy Technology	PEC	3	0	0	3	3
3	PEE603	Design and Modeling of Renewable Energy Systems	PEC	3	0	0	3	3
4	PEE604	Grid integrating Techniques and Challenges	PEC	3	0	0	3	3
5	PEE605	Wind Energy Conversion Systems	PEC	3	0	0	3	3
6	PEE606	Solar and Wind Energy Engineering	PEC	3	0	0	3	3

OPEN ELECTIVE COURSES								
S.No.	Course Code	Course Title	Course Offering Department	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	OAD101	Foundation of Data Science	AIDS	3	0	0	3	3
8	OAD102	Open Source Software Tools	AIDS	3	0	0	3	3
9	OCS101	IoT and its Applications	CSE	3	0	0	3	3
10	OCS102	Machine Learning with R	CSE	3	0	0	3	3
11	OCS103	Tamil Computing	CSE	3	0	0	3	3
12	OCY101	Cyber Forensic and Investigation	CYB	3	0	0	3	3
13	OCY102	Social Media Security	CYB	3	0	0	3	3
14	OEC101	Introduction to 5G Communication Networks	ECE	3	0	0	3	3
15	OEC102	Introduction to Industrial IoT	ECE	3	0	0	3	3
16	OEC103	Arduino Programming and its Applications	ECE	3	0	0	3	3
17	OMD101	Introduction to Food Processing	MDE	3	0	0	3	3
18	OMD102	Introduction to Biomedical Instrumentation	MDE	3	0	0	3	3
19	OEI101	Fundamentals of Robotics	EIE	3	0	0	3	3
20	OEI102	Sensors for Engineering Applications	EIE	3	0	0	3	3
21	OIT101	Multimedia Technologies	IT	3	0	0	3	3
22	OIT102	3D Printing and Its Applications	IT	3	0	0	3	3
23	OIT103	Web Frameworks	IT	3	0	0	3	3
24	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	OCH101	Nanomaterials and Applications	CHE	3	0	0	3	3
30	OPH101	Advanced Functional Materials	PHY	3	0	0	3	3

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

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

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.

MINOR DEGREE COURSES

VERTICAL I: FINTECH AND BLOCK CHAIN								
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	CSM102	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	Datamining 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

MINOR DEGREE COURSES

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

MINOR DEGREE COURSES

VERTICAL I: FINTECH AND BLOCK CHAIN								
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 Block chain and its Applications	PEC	3	0	0	3	3
5	BAM104	Fintech Personal Finance and Payments	PEC	3	0	0	3	3
6	CSM102	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 & Leadership Management for Business	PEC	3	0	0	3	3
3	BAM203	Creativity & Innovation in Entrepreneurship	PEC	3	0	0	3	3
4	BAM204	Principles of Marketing Management for Business	PEC	3	0	0	3	3
5	BAM205	Human Resource Management for Entrepreneurs	PEC	3	0	0	3	3
6	BAM206	Financing New Business Ventures	PEC	3	0	0	3	3

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

VERTICAL IV: BUSINESS DATA ANALYTICS								
S.No.	Course Code	Course Title	Category	Contact Periods				C
				L	T	P	Total	
1	BAM401	Statistics For Management	PEC	3	0	0	3	3
2	BAM402	Datamining 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	CEM501	Sustainable infrastructure Development	PEC	3	0	0	3	3
2	AGM501	Sustainable Agriculture and Environmental Management	PEC	3	0	0	3	3
3	CEM502	Sustainable Bio Materials	PEC	3	0	0	3	3
4	CEM503	Materials for Energy Sustainability	PEC	3	0	0	3	3
5	CEM504	Green Technology	PEC	3	0	0	3	3
6	CEM505	Environmental Quality Monitoring and Analysis	PEC	3	0	0	3	3
7	CEM506	Integrated Energy Planning for Sustainable Development	PEC	3	0	0	3	3
8	CEM507	Energy Efficiency for Sustainable Development	PEC	3	0	0	3	3

SUMMARY										
Sl.No	Subject Area	Credits per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	HSMC	5	4				2	2		13
2	BSC	12	10	3	2					27
3	ESC	5	10			2				17
4	PCC			19.5	19.5	16.5	10.5	9		75
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	22.5	21.5	24.5	21.5	21	10	167

SEMESTER I

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

COURSE OBJECTIVES

1. To upgrade the English language skills of students by introducing communication techniques, speaking and grammar learning activities which are relevant to authentic contexts.
2. To improve the basic reading and writing skills of the learners.
3. To enhance the communicative competence of the first-year engineering students.
4. To enable learners to use language effectively in academic/work contexts.
5. 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

At the end of the course, learners will be able

1. To strengthen the basics of grammar.
2. To narrate informal and informal situations.
3. To describe a process/product and express opinion.
4. To interpret and analyse the content/information given.
5. 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, New Delhi, 2016.

REFERENCE BOOKS

1. Effective Communication Skill, Kulbhusan Kumar, R.S.Salaria, Khanna
Publishing House, January, 2016.
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, 2019.
4. Professional Speaking skills, Aruna Koneru, Oxford University Press, 2018.
5. English For Engineers and Technologists, Orient Blackswan Private Ltd.,
Department of English, Anna University, 2020.

CO - PO and CO - PSO MAPPING

EN3111	PROGRAM OUTCOMES												PSO's			
	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	-	-	-	-	-	-
Average	2.2	2.7	2.0	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-

MA3122	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

1. To understand and apply matrix techniques for engineering applications.
2. To familiarize the student with basic calculus and traditional calculus.
3. To solve the problems in single and multivariable calculus and plays an important role in science, economics, engineering.
4. Vector calculus can be widely used for modelling the various laws of physics.
5. 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

COURSE OUTCOMES

1. To apply the idea of reducing complex problems into simple form using matrix technique.
2. Basic application of calculus in engineering problems and to tackle for different geometries.
3. This course equips the students to have basic knowledge and understanding of the partial derivatives and maxima and minima by Lagrange's method.
4. Basic application of Double and Triple integrals used in Engineering real life problems.
5. To study Vector differentiation and vector integration by standard theorems.

TEXT BOOKS

1. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.
2. Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", S.Chand Co. Pvt. Ltd., 11th Edition, 2005.
3. Veerarajan.T, "Engineering Mathematics", Mc Graw Hill 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.

CO - PO and CO - PSO MAPPING

MA3122	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
Average	3.0	2.0	2.0	1.0	-	-	-	-	-	-	-	1.0	-	-	-	-

COURSE OBJECTIVES

1. To enhance the fundamental knowledge in crystalline materials and its application in the engineering field.
2. To explore the knowledge in the production of ultrasonic waves and application in the engineering field.
3. To familiarize the basics of laser and their technical advances in scientific, industrial and health care areas.
4. To understand the principle of optical fibre and its applications
5. 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

COURSE OUTCOMES

1. To understand the properties of materials, crystalline material and growth technique.
2. To understand the basics, generation and application of ultrasonics.
3. To acquire knowledge on the concepts of lasers and their applications in industry and medical field.
4. To conversant on principle behind the fibres and their applications in communication and devices made out of optical fibre.
5. 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. M. Arumugam," Engineering Physics", Anuradha agencies and publishers.

5. M.N.Avadhanulu & P.G.Krishnasagar, "A Text Book of Engineering Physics" – IX Edition, S.Chand Publications, 2014.
6. V. Rajendiran, Engineering Physics, Tata McGraw Hill publishing company Ltd., 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

PH3123	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	1	-	-	1	1	-	-	-	-	1	-	-	-	-
CO2	3	1	1	1	2	1	1	-	-	-	-	1	-	-	-	-
CO3	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
CO4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-	-
CO5	2	1	1	1	1	1	1	-	-	-	-	1	-	-	-	-
Average	2.8	1.4	1.4	1.0	1.3	1.0	1.0	-	-	-	-	1.0	-	-	-	-

OBJECTIVES

1. To make the students familiar with boiler feed water requirements, related problems and domestic water treatment techniques.
2. To introduce the basic concepts and applications of chemical thermodynamics.
3. To acquaint the student with the principles of chemical kinetics and its applications towards engineering.
4. To make the student conversant with the basics of surface chemistry and catalysis.
5. 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: 45 PERIODS

COURSE 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.

CO - PO and CO - PSO MAPPING

CH3124	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	2	-	1	3	-	-	-	-	2	-	-	-	-
CO2	3	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	1		-	-	-	-	-	-	-	-	-	-	-	-
CO5	2	2	3	2	1	-	1	-	-	-	-	2	-	-	-	-
Average	2.8	1.8	2.2	1.5	1.0	1.0	2.0	-	-	-	-	2.0	-	-	-	-

GE3133	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

1. To impart basic knowledge on Civil and Mechanical Engineering.
2. To familiarize the materials and measurements used in Civil Engineering.
3. To provide the exposure on the fundamental elements of civil engineering structures and construction methods.
4. To enable the students to distinguish the components and working principle of power plant units, boilers, IC engines and Electric vehicle.
5. To understand the concepts and working principle of pumps and refrigeration and air conditioning systems.

A – OVER VIEW

UNIT – I : SCOPE OF CIVIL AND MECHANICAL ENGINEERING 9

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

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

B – CIVIL ENGINEERING

UNIT – II : SURVEYING AND CIVIL ENGINEERING MATERIALS 9

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

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

UNIT – III : BUILDING COMPONENTS AND STRUCTURES

9

Foundations: Types of foundations - Requirement of good foundations.

Civil Engineering Structures: Brick masonry - stone masonry - beams - columns - lintels - roofing- flooring - plastering - floor area, carpet area and floor space index - Rain water harvesting - introduction to high way and railway.

C – MECHANICAL ENGINEERING

UNIT – IV : INTERNAL COMBUSTION ENGINES AND POWER PLANTS

9

Introduction to internal combustion engine - Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines- Introduction to Electric vehicle. Classification of Power Plants-Working principle of steam, Gas, Diesel, Hydro - electric and Nuclear Power plants-working principle of Cochran, Lamont, Benson Boilers.

UNIT – V : PUMPS , REFRIGERATION AND AIR CONDITIONING

9

Reciprocating Pumps -single acting and double acting and Centrifugal Pumps. Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Knowledge of basics in various sub-disciplines of civil and mechanical Engineering.
2. Use the basics of surveying for calculation of area and volume in basic construction works
3. Fundamental elements of civil engineering structures and construction methods.
4. Understand the energy sources , working principle of power plants and working principle of IC Engines and Electric vehicle.
5. Understand the working principle of pumps and function of refrigeration and air conditioning system.

TEXTBOOKS:

1. Shanmugam G and Palanichamy MS, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., New Delhi, 2018.
2. Basant Agrawal and C.M.Agrawal, "Basic Mechanical Engineering", Wiley Publications Pvt Ltd., New Delhi, 2018.
3. Venugopal K. and Prabhu Raja V., " Basic Civil and Mechanical Engineering", Anuradha publications Pvt. Ltd., Chennai, 2014.
4. Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals, Second Edition" CRC Press, Taylor & Francis Group, Second Edition, 2011.
5. Satheesh Gopi, "Basic Civil Engineering", Pearson publications, 2009.

REFERENCE BOOKS:

1. Rajput R.K., "Thermal Engineering", Laxmi Publications (P) Ltd, 10th Edition, 2018.
2. Ramamrutham S., "Basic Civil Engineering", Dhanpat Rai Publishing Co.(P) Ltd., 2015.
3. Kothandaraman C.P., Domkundwar S., Dhanpat Rai, "Thermal Engineering", Publishing Co.(P) Ltd., 6th Edition, 2015.
4. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel cell Vehicles" CRC Press, Taylor & Francis Group, Second Edition, 2010.

CO - PO and CO - PSO MAPPING

GE3133	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	2	-	-	3	2	1	-	-	-	1	-	-	-	-
CO2	3	3	2	1	-	1	-	-	-	-	-	-	-	-	-	-
CO3	3	1	2	1	-	1	1	-	-	-	-	-	-	-	-	-
CO4	3	2	2	1	-	1	-	-	-	-	-	1	-	-	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-
Average	3.0	1.8	2.0	1	-	1.5	1.5	1	-	-	-	1	-	-	-	-

அலகு - I மமொழி மற்றும் இலக்கியம்**3**

இந்திய மமொழிக் குடும்பங்க - திரொவிட மமொழிகள்- தமிழ் ஓ
 ள்
 மெம்மமொழி- தமிழ் மெவ்விலக்கியங்கள்- ஂங்க இலக்கியத்தின் மெய்ய்
 ஂஂர்பற்ற தன்மம் - ஂங்க இலக்கியத்தில் பகிர்தல் அறம்-
 திருக்குறளில் மமலொண்மமக் கருத்஑கள்- தமிழ்க் கொப்பியங்கள்,
 தமிழகத்தில் மெண மபௌத்த மெயங்களின் தொக்கம் - பக்தி இலக்கியம்,
 ஆழ்வார்கள் மற்றும் நொயன்மொர்கள்- சிற்றிலக்கியங்கள்- தமிழில்
 நவீன இலக்கியத்தின் வளர்ஂசி - தமிழ் இலக்கிய வளர்ஂசியில் பொரதியொர்
 மற்றும் பொரதிதொஂன் ஆகிமயொரின் பங்களிப்பு

அலகு - II மரபு – பொற்ற ஓவியங்கள் முதல் நவீன ஓவியங்கள் –
சிற்பக் கறல
3

நடுகல் முதல் நவீன சிற்பங்கள் வமர -ஐம்மபொன் சிமலகள் -
 பழங்குடியினர் மற்றும் அவர்கள் தயொரிக்கும் மகவிமனப் மபொருட்கள்
 , மபொம்மமகள்- மதர் மெய்யும் கமல - சுடுமண் சிற்பங்கள்

அலகு - III நொட்டுபுறக் கறலகள் மற்றும் வீர விறளயொட்டுகள்**3**

நொட்டுப்புற கமதகள், பொடல்கள்-மதருக்கூத்஑, கரகொட்டம், வில்லுப்பொட்டு,
 கணியொன் கூத்஑- ஓயிலொட்டம், மதொல்பொமவக் கூத்஑, சிலம்பொட்டம்- வளரி,
 புலியொட்டம், தமிழர்களின் விமளயொட்டுகள்

அலகு - IV தமிழர்களின் திறைக் ககொட்பொடுகள்**3**

தமிழகத்தின் தொவரங்களும், விலங்குகளும் - மதொல்கொப்பியம் மற்றும்
 ஂங்க இலக்கியத்தில் அகம் மற்றும் புறக் மகொட்பொடுகள்- தமிழர்கள்
 மபொற்றிய அறக்மகொட்பொடு -தமிழ் ஂங்கம்-ஂங்கம் வளர்த்த தமிழ்-
 ஂங்ககொலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும்-
 ஂங்ககொல நகரங்களும் ஑மறமுகங்களும் - ஂங்ககொலத்தில்
 ஏற்றுமதி மற்றும் இறக்குமதி கடல்கடந்த நொடுகளில் மொழர்களின்

பைப்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு

இந்திய விடுதலப்மபொரில் தமிழர்களின் பங்கு இந்தியொ மற்றும் மவளிநொட்டின் பிற பகுதிகளின் தமிழ்ப் பண்பொட்டின் தொக்கம்- சுயமொரியொமத இயக்கம்- இந்திய மருத்வத்தில், சித்த மருத்வத்தின் பங்கு- கல்மவட்டுகள், மகமயமுத்வப்படிகள் - தமிழ்ப் புத்தகங்களின் ஁சு வரலொறு

TOTAL : 15 PERIODS

TEXT CUM REFERENCES.

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

UNIT - I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages - Tamils 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, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT - IV THINAI CONCEPT OF TAMILS 3

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

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

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

TOTAL : 15 PERIODS

TEXT CUM REFERENCES:

1. தமிழக வரலாறு - மக்களும் பண்பொடும் - மக.மக.பிள்மள (மவளியீடு: தமிழ்நாடு பொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித்தமிழ் - முமனவர். இல.சுந்தரம். (விகடன் பிரசுரம்)
3. கீழடி - மவமக நதிக்கமரயில் ஂங்ககொல நகர நொகரிகம் (மதொல்லியல் Fமற மவளியீடு)
4. மபொருமந - ஆற்றங்கமர நொகரிகம். (மதொல்லியல் Fமற மவளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (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 OBJECTIVES:

The course aims to

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

UNIT - I PRONUNCIATION 6

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

UNIT - II NON VERBAL COMMUNICATION 6

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

UNIT - III SELF INTRODUCTION AND PRESENTATION 6

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

UNIT - IV BASICS OF SOFT SKILLS 6

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

UNIT - V GROUP DISCUSSION 6

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

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

1. Pronounce the words correctly.
2. Understand the non verbal clues.
3. Make an effective presentation Make an effective presentation
4. Adequate soft skills required for the workplace.
5. Participate confidently in Group Discussions.

REFERENCE BOOKS

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., New Delhi, 2015.

CO - PO and PSO MAPPING

EN3119	PROGRAM OUTCOMES												PSO's			
	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	-	-	-	-
Average	1.7	1.3	1	1.3	2	-	2	-	-	2.8	-	1	-	-	-	-

PHYSICS LABORATORY:**COURSE OBJECTIVES:**

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

LIST OF EXPERIMENTS(Any five experiments to be conducted)

- 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**COURSE OUTCOMES****Upon completion of the course, the students will be able to**

1. Understand the functioning of various physics laboratory equipment.
2. Use Graphical models to analyse 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.

REFERENCE BOOKS

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

CO - PO and CO - PSO MAPPING

GE3121	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	3.0	2.4	2.6	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-

CHEMISTRY LABORATORY:

OBJECTIVES

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

LIST OF EXPERIMENTS (Any five experiments to be conducted)

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

COURSE 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).

CO - PO and CO - PSO MAPPING

GE3121	PROGRAM OUTCOMES												PSO			
	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	-	-	-	-	-	-	-	-	-	-	-
Average	2.0	1.0	0.8	1.0	1.2	-	1.0	-	-	-	-	1.0	-	-	-	-

COURSE OBJECTIVES:

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

GROUP A (CIVIL & MECHANICAL)**LIST OF EXPERIMENTS : CIVIL****a) Buildings**

- 1 Study of plumbing and carpentry components of residential and industrial buildings safety aspects.

b) Plumbing Works:

- 1 Study of pipeline joints, its location and functions : valves, taps, couplings, unions, reducers, elbows in house hold fittings.
- 2 Study of pipe connections requirements for pumps and turbines.
- 3 Preparation of plumbing line sketches for water supply and sewage works.
- 4 Hands-on-exercise:

Basic pipe connections - Mixed pipe material connection - Pipe connections with different joining components.
- 5 Demonstration of plumbing requirements of high-rise buildings.

Carpentry works:

- 1 Study of the joints in roofs, doors, windows and furniture.
- 2 Hands-on-exercise: Wood work, joints by sawing, planning and cutting.

LIST OF EXPERIMENTS : MECHANICAL

a) Welding:

- 1 Preparation of butt joints, lap joints and T-joints by Shielded metal arc welding.
- 2 Gas welding practice - Study

b) Basic Machining:

- 1 Facing
- 2 Simple Turning
- 3 Step Turning

c) Sheet Metal Work:

- 1 Forming & Bending
- 2 Model making-Trays

d) Demonstration on:

- 1 Smithy operations, upsetting, swaging, setting down and bending.
- 2 Foundry operations like mould preparation for gear and step cone pulley.
- 3 Assembly of centrifugal pump.
- 4 Assembly of air conditioner.

GROUP B (ELECTRICAL & ELECTRONICS)

LIST OF EXPERIMENTS : ELECTRICAL

1. Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket.
2. Light and Fan 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.

LIST OF EXPERIMENTS : ELECTRONICS

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

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

- 1 To Carry out various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
- 2 To Fabricate carpentry components and pipe connections including plumbing works and use welding equipment's to join the structures.
- 3 To Carry out the basic machining operations, make the models using sheet Metal works. Illustrate on centrifugal pump, air conditioner, operations of smithy, foundry and fittings.
- 4 To Carry out basic home electrical works and measure the electrical quantities.
- 5 To Elaborate on the electronics components, gates and soldering practices.

REFERENCE BOOKS

1. Laboratory Manual prepared by Course Coordinator

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

ELECTRICAL

Sl. No.	Description of Equipment	Required numbers (for batch of 30 students)
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.	Meggar	2

ELECTRONICS

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

CO - PO and CO - PSO MAPPING

GE3134	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-
CO2	-	1	2	-	3	-	-	-	-	-	1		-	-	-	-
CO3	-	-	-	3	2	-	-	-	-	-	-	1	-	-	-	-
CO4	-	2	3	1	2	-	-	-	-	-	-		-	-	-	-
CO5	-	3	2	2	-	-	-	-	1	-	-		-	-	-	-
Average	3.0	2.0	2.3	2.0	2.3	1.0	-	-	1.0	-	1.0	1.0	-	-	-	-

SEMESTER II

EN3211

PROFESSIONAL ENGLISH – II

L T P C

3 0 0 3

COURSE OBJECTIVES

The course prepares the second semester Engineering students

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

UNIT - I MAKING COMPARISON

9

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

Speaking: Descriptions and discussions based on newspaper.

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

Writing: Compare & Contrast essays and Jumbled Sentences.

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

UNIT - II EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING

9

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

Speaking: Marketing a product, persuasive speech

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

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

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

UNIT - III ABILITY TO PUT IDEAS OR INFORMATION COGENTLY 9

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

Speaking: Role play and Interviews

Reading: Reading magazine articles, Excerpts from literary texts

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

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

UNIT - IV ANALYZING PROBLEMS AND EXPRESSING SOLUTIONS 9

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

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

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

Writing: Dialogue Writing, Checklist and Problem Solving essays.

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

UNIT - V REPORTING EVENTS 9

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

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

Reading: Reading life experiences of common man from magazines.

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

1. To compare and contrast ideas and information from technical texts.
2. To incorporate basic grammar structures to express appreciation, suggestion and complaint in writing.
3. To draft effective resumes using appropriate vocabulary and to avoid common errors.
4. To analyse problems so as to arrive at appropriate solutions and to communicate relevantly.
5. To draft technical reports, letters and to express ideas creatively.

TEXT BOOKS

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

REFERENCE BOOKS

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

CO - PO and PSO MAPPING

EN3211	PROGRAM OUTCOMES												PSO's			
	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	-	-	-	-	-	-
Average	2.0	2.0	1.4	2.0	2.0	-	2.0	-	-	2.8	1.0	1.0	-	-	-	-

COURSE OBJECTIVES

1. This course aims at providing the necessary basic concepts of statistical and Numerical Methods for solving numerically different problems of engineering and Technology.
2. To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
3. To introduce the basic concepts of solving algebraic and transcendental equations.
4. To introduce the numerical techniques of interpolation in various intervals and differentiation and integration in engineering and technology disciplines.
5. 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 9

EQUATIONS

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 PERIODS

COURSE OUTCOMES

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

1. Apply the concept of testing of hypothesis for small and large samples in real life problems.
2. Apply the basic concepts of classifications design of experiments in the field of agriculture.
3. Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
4. Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
5. 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, New Delhi, 2006.

CO - PO and PSO MAPPING

MA3222	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Average	3.0	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

COURSE OBJECTIVES

1. To understand the concept of free electron theories and to get knowledge on conducting and superconducting materials.
2. To impart the knowledge about basics of doping and types of semiconductors.
3. To enable the idea of magnetism and dielectric properties.
4. To explore the basics of interaction of photon with materials.
5. 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-Franzlaw-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 - kdielectrics.

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 - photodetectors- 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(quantative)- 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

COURSE OUTCOMES

At the end of the course, the student 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 nanoelectronics.

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. S. Salivahan, A.Rajalakhmi, S.Karthie and N.P.Rajesh,” Physics for Electronics Engineering and Information Science”, Mc Graw Hill Education, 2018.

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, 2007.
3. Rogers,B. ,Adams, J.& Pennathur,S. “Nanotechnology: Understanding Small Systems”, CRC Press, 2014.

CO - PO and PSO MAPPING

PH3223	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	-	-	1	1		-	-	-	-	1	-	-	-	-
CO2	3	2	2	-	2	-	-	-	-	-	-	1	-	-	-	-
CO3	3	2	1	1	-	2	-	-	-	-	-	1	-	-	-	-
CO4	3	-	1	-	3	2	3	-	-	-	-	1	-	-	-	-
CO5	3	-	2	1	2	1	-	-	-	-	-	1	-	-	-	-
Average	3.0	1.7	1.5	1.0	2.0	1.5	3.0	-	-	-	-	1.0	-	-	-	-

OBJECTIVES

1. To make the students accustomed to carbon-based materials, their synthetic properties, and their application in the field of electrical and electronics.
2. To comprehend the synthetic properties and applications of polymers in engineering applications.
3. To acquaint the student with the principles of electrochemical reactions, and corrosion.
4. To understand the working principle and applications of analytical instruments in chemical analysis.
5. 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 (H_2 - O_2 fuel cell). Supercapacitors: storage principle, applications. Electric vehicles-working principles.

UNIT - V INSTRUMENTAL METHODS AND ANALYSIS

9

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: 45 PERIODS

COURSE 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.

CO - PO and PSO MAPPING

CH3223	PROGRAM OUTCOMES												PSO's			
	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	-	-	-	-
Average	2.6	2.4	2.2	1.8	1.7	1.0	1.0	-	-	-	-	2.0	1.5	-	-	-

GE3231	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	(Common to All branches)	3	0	0	3

COURSE OBJECTIVES

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

UNIT- I PYTHON BASICS 9

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

UNIT - II FUNCTIONS, LIST, TUPLES 9

Functions, function definition and use. **Fruitful functions:** return values, parameters, local and global scope, recursion. **Lists:** list operations, list slices, list methods, list loop, mutability, list parameters; **Tuples:** tuple assignment, tuple as return value. Comparison of Lists and tuples. Illustrative programs: exchange the values of two variables, square root, Linear and Binary search. Fibonacci series using functions.

UNIT - III STRINGS, DICTIONARY, SET 9

Strings: string slices, immutability, string functions and methods, string module. **Dictionaries:** Operations (create, access, add, remove) and methods. (Insert, delete). Set operation (Access, Add, Remove). Illustrative programs: creates a dictionary of radius of a circle and its circumference.

Files and exception: Text Files, Reading and Writing files, Format operator; Errors and Exceptions, Handling Exceptions, Multiple Except blocks, Modules, Packages; Illustrative programs: word count, copy file, Creating user defined Exceptions.

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

1. Develop simple computational problems using control flow statements.
2. Decompose a Python program into functions, Modules and Packages.
3. Represent compound data using Python lists, tuples, Strings, Set and dictionaries.
5. Read and write data from/to files and Exception handling in Python Programs.
5. Understand the concepts of Object Oriented Programming and to develop real time applications

TEXTBOOKS

1. ReemaThareja, "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.

REFERENCE BOOKS

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

WEB REFERENCES

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

CO - PO and PSO MAPPING

GE3231	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	2	-	-	-	-	-	2	2	-	-	-	-
CO2	3	3	3	3	2	-	-	-	-	-	2	2	-	-	-	-
CO3	3	3	3	3	2	-	-	-	-	-	2	-	-	-	-	-
CO4	2	2	-	2	2	-	-	-	-	-	1	-	-	-	-	-
CO5	1	2	-	-	1	-	-	-	-	-	1	-	-	-	-	-
Average	2.4	2.6	3.0	2.8	1.8						1.6	2.0				

அலகு - I மநசவு மற்றும் பொறனத் மதொழில்நுட்பம் 3

ெங்க கொலத்தில் மநெவுத் மதொழில் - பொமனத் மதொழில்நுட்பம் - கருப்பு சிவப்பு பொண்டங்கள் - பொண்டங்களில் கீறல் குறியீடுகள்.

அலகு- II வடிவறமப்பு மற்றும் கட்டிடத் மதொழில்நுட்பம் 3

ெங்க கொலத்தில் வடிவறமப்பு மற்றும் கட்டுமொனங்கள் & ெங்க கொலத்தில் வீட்டுப் மபொருட்களில் வடிவறமப்பு. ெங்க கொலத்தில் கட்டுமொன மபொருட்களும் நடுகல்லும் - சிலப்பதிகொரத்தில் மமமட அமமப்பு பற்றிய விவரங்கள் - மொமல்லபுரே சிற்பங்களும், மகொவில்களும் - மொழர் கொலத்ஃப் மபருங்மகொயில்கள் மற்றும் பிற வழிபொட்டுத் தலங்கள் - நொயக்கர் கொலக் மகொயில்கள் - மொதிரி கட்டமமப்புகள் பற்றி அறிதல், MFமர மீனொட்சி அமிமன் ஆலயம் மற்றும் திருமமல நொயக்கர் மஹொல் - மெட்டிநொட்டு வீடுகள் - பிரிட்டிஷ் கொலத்தில் மென்மனயில் இந்மதொ - ெொமரொமெனிக் கட்டிடக் கமல

அலகு - III உற்பத்தித் மதொழில்நுட்பம் 3

கப்பல் கட்டும் கமல - உமலொகவியல் - இருமப்புத் மதொழிற்ெொமல - இருமம்மப உருக்குதல், எஃகு - வரலொற்றுெ் ெொன்றுகளொகெ் மெமப்பு மற்றும் தங்க நொணயங்கள் - நொணயங்கள் ெெட்டித்தல் - மணி உருவொக்கும் மதொழிற்ெொமலகள் - கல்மணிகள், கண்ணொடி மணிகள் - சுடுமண் மணிகள் - ெங்கு மணிகள் - எலும்புத்ஃண்டுகள் - மதொல்லியல் ெொன்றுகள் - சிலப்பதிகொரத்தில் மணிகளின் வமககள்

அலகு - IV கவளொண்்றம மற்றும் நீர்ப்பொசனத் மதொழில்நுட்பம் 3

அமண, ஏரி, குளங்கள், மதகு - மொழர்கொலக் குழுழித் தூம்பின் முக்கியத்ஃவம் - கொல்நமட பரொமரிப்பு - கொல்நமடகளுக்கொக வடிவறமக்கப்பட்ட கிணறுகள் - மவளொண்மம மற்றும் மவளொண்மமெ் ெொர்ந்த மெயல்பொடுகள் - கடல்ெொர் அறிவு - மீன்வளம் - முத்ஃ மற்றும் முத்ஃக்குளித்தல் - மபருங்கடல் குறித்த பண்மடய அறிவு - அறிவுெொர் ெொுகம்.

அறிவியல் தமிழின் வளர்ச்சி – கணித்தமிழ் வளர்ச்சி – தமிழ் நூல்கள மின்பதிப்பு மெய்தல் – தமிழ் மமன்மபொருட்கள் உருவாக்கம் – தமிழ் இமணயக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இமணயத்தில் தமிழ் அகராதிகள் – மொற்குமவத் திட்டம்.

TEXT CUM REFERENCES.

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

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 Thoompu of Chola Perio, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries - Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT - V SCIENTIFIC TAMIL & TAMIL COMPUTING**3**

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

TOTAL : 15 PERIODS

TEXT – CUM – REFERENCE BOOKS

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

GE3233	ENGINEERING GRAPHICS AND DESIGN	L	T	P	C
	(Common to all branches of B.E. / B.Tech. Programmes)	1	0	4	3

OBJECTIVES:

The main learning objective of this course is to impart knowledge

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

CONCEPTS AND CONVENTIONS (Not for Examination) 1

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

UNIT – I : PLANE CURVES AND SPECIAL CURVES 10

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

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

Orthographic projection- Principles-Principal planes - First angle projection-projection of points at 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 16

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 16

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 16

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

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

COURSE OUTCOMES:

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

1. To construct the conics curves and special curves, use BIS conventions, and specifications for engineering drawing.
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. Natarajan K.V., "A Text Book of Engineering Graphics" Dhanalakshmi Publishers, Chennai, 2018.
3. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2011.
4. 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.
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 and PSO MAPPING

GE3233	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	2	-	2	-	-	-	-	3	-	2	-	-	-	-
CO2	3	1	2	-	2	-	-	-	-	3	-	2	-	-	-	-
CO3	3	1	2	-	2	-	-	-	-	3	-	2	-	-	-	-
CO4	3	1	2	-	2	-	-	-	-	3	-	2	-	-	-	-
CO5	3	1	2	-	2	-	-	-	-	3	-	2	-	-	-	-
Average	3.0	1.0	2.0	-	2.0	-	-	-	-	3.0	-	2.0	-	-	-	-

PHYSICS LABORATORY:**COURSE OBJECTIVES:**

1. To gain practical knowledge and to correlate with the theoretical studies.
2. To achieve perfectness in experimental skills and the study of practical applications.
3. To bring more confidence and ability to develop and fabricate engineering and technical equipment.
4. To Learn problem solving skills related to physics principles and interpretation of experimental data
5. To make the students as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS (Any five experiments)

- 1 To determine 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 Resistor(LDR)
- 9 Measurement of Temperature using LM35.

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

1. Understand the functioning of various physics laboratory equipment.
2. 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 in individually and collaboratively.

TEXTBOOKS:

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

CO - PO and PSO MAPPING

GE3221	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	1	1	-	-	-	-	-	-	-	-	-	-	-
Average	3.0	2.4	2.6	1.0	1.0	-	-	-	-	-	-	-	-	-	-	-

CHEMISTRY LABORATORY:

OBJECTIVES

1. To train the students in basic experimental skills in water contaminants such as copper and chromium.
2. To familiarise the students with electroanalytical techniques such as pH metry, potentiometry, and conductometry to determine impurities in aqueous solutions.
3. To familiarize the students with the determination of the molecular weight of a polymer by a viscometer.
4. To make the student up-to-date with the properties and nature of alloys experimentally.
5. To demonstrate the analysis of coal.

LIST OF EXPERIMENTS (Any 5-Experiments)

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

TOTAL: 30 PERIODS

COURSE 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).

CO - PO and PSO MAPPING

GE3221	PROGRAM OUTCOMES												PSO's			
	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	-	-	-	-	-	-	-	-	-	-	-
Average	2.0	1.4	1.0	1.0	1.2	2.0	1.5	2.0	-	-	-	-	-	-	-	-

COURSE OBJECTIVES:

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

TOTAL: 60 PERIODS

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

COURSE OUTCOMES

1. Develop solutions to simple computational problems using Python programs.
2. Solve problems using conditionals and loops in Python.
3. Develop Python programs by defining functions and calling them.
4. Use Python lists, tuples and dictionaries for representing compound data.
5. Develop Python programs using files and OOPS concept.

CO - PO and PSO MAPPING

GE3232	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	3	-	-	-	-	-	3	2	-	-	-	-
CO2	3	3	3	3	3	-	-	-	-	-	3	2	-	-	-	-
CO3	3	3	3	3	2	-	-	-	-	-	2	-	-	-	-	-
CO4	3	2	-	2	2	-	-	-	-	-	1	-	-	-	-	-
CO5	1	2	-	-	1	-	-	-	-	-	1	-	-	-	-	-
Average	2.6	2.6	3.0	2.8	2.2						2.0	2.0	-	-	-	-

Unit – 1 : 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. 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 / YRC / NSO / CLUB ACTIVITIES

National Sports Organization (NSO)

OBJECTIVES:

1. To create awareness about basic fitness and mental strength
2. To promote the development of physical fitness
3. To develop the sporting activities of the youth
4. 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/>

NSS / YRC / NSO / CLUB ACTIVITIES

YOUTH RED CROSS – Social Service based activities

OBJECTIVES:

1. To enhance the societal awareness
2. To upgrade the Personality

ACTIVITIES

5

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

COURSE OUTCOME

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

References:

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

NSS / YRC / NSO / CLUB ACTIVITIES

தமிழ் மன்றம்

பொடத்திட்டத்தின் கநொக்கங்கள்

1. மொணவர்கமள சிறந்த மமமடம்மெப்ெொளர்களாக உருவொக்குவF
2. தொய்மமொழியின் மமன்மமமய பொFகொப்பF..

பயிற்சித்திட்டம்

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

கற்றல் முடிவு

1. மெப்சுக்கமலப் தேர்ச்சி
2. நாட்டுப்புறப்பாடல்கள் பற்றிய புரிதல்

கமற்ககொள்கள்

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

RESONANCE – SKILL BASED ACTIVITIES

OBJECTIVES:

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

ACTIVITIES

5

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

COURSE OUTCOME

Students were able to:

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

REFERENCES:

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

NSS / YRC / NSO / CLUB ACTIVITIES

Eclectic Lingua – Skill based activities

OBJECTIVES:

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

ACTIVITIES

5

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

COURSE OUTCOME

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

References

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

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

NSS / YRC / NSO / CLUB ACTIVITIES

EULER.COM – Skill based activities

OBJECTIVES:

1. To enhance the Logical reasoning of the first-year engineering students by means of creating opportunity to improve the aptitude skill.
2. 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/>

NSS / YRC / NSO / CLUB ACTIVITIES

Fine Arts Club VECTORIANS – Skill based activities

OBJECTIVES:

1. To enhance the inbuilt talents in arts and crafts and fine arts activities.
2. 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

NSS / YRC / NSO / CLUB ACTIVITIES

Catalysis – Skill-based activities

Objectives:

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

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

COURSE OUTCOME

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

REFERENCE

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

SEMESTER - III

MA3321	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT - I PARTIAL DIFFERENTIAL EQUATIONS 9

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

UNIT - II FOURIER SERIES 9

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

UNIT - III LAPLACE TRANSFORMS 9

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

UNIT - IV FOURIER TRANSFORMS 9

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Understand the fundamental concept of the concepts of Partial differential Equations.
2. Understand the basic concepts of mathematical principles on Fourier & Z-transforms.
3. Laplace transform and inverse transform of simple functions, properties, are studied.
4. Apply the concept of Understand the concept Fourier series and apply the concept in solving PDE.
5. Understand the fundamental concept of the concepts of Solution of difference equations.

TEXT BOOKS

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

REFERENCE BOOKS

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd., 2007.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.

4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt. Ltd., Sixth Edition, New Delhi, 2012.
6. P.Sivaramakrishna Das, C.Vijayakumari, Transforms and Partial Differential Equations, Pearson India Education Services Pvt. Ltd., 2019.

CO - PO and CO - PSO MAPPING

MA3321	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO2	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO3	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO4	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
CO5	3	3	-	-	1	-	-	-	-	-	-	1	-	-	-	-
Average	3.0	3.0	-	-	1.0	-	-	-	-	-	-	1.0	-	-	-	-

OBJECTIVES:

1. To gain conceptual and basic mathematical understanding of vector analysis on fields.
2. To impart knowledge on the basics of static electric field and the associated laws.
3. To impart knowledge on the basics of static magnetic field and the associated laws
4. To study the significance of Time varying fields.
5. To understand the behaviour of the propagation of EM waves.
6. 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's 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

1. Relate the fundamentals of vector, coordinate system to electromagnetic concepts.
2. Analyze the concepts and characteristics of Electrostatic field in material space and solve the boundary conditions.
3. Illustrate the concepts and characteristics of Magnetostatic field in material space and solve boundary conditions.
4. Determine the significance of time varying fields.
5. Apply EM laws for the propagation of plane waves through different medium.
6. 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.

CO - PO and CO - PSO MAPPING

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	1	-	-	-	-	-	-	-	-	2	2	1
CO2	3	2	1	2	-	-	-	-	-	-	-	1	2	1
CO3	3	2	1	2	-	-	-	-	-	-	-	1	2	1
CO4	2	2	1	-	-	-	-	-	-	-	-	2	2	1
CO5	3	2	1	2	-	-	-	-	-	-	-	2	2	1
CO6	2	2	1	2	-	-	-	-	-	-	-	2	2	1
Avg	3	2	1	2	-	-	-	-	-	-	-	2	2	1

COURSE OBJECTIVES:

1. To introduce the fundamentals of combinational and sequential digital circuits.
2. To study various number systems and to simplify the mathematical expressions using Boolean functions word problems
3. To study implementation of combinational circuits using Gates and MSI Devices
4. To study the design of various synchronous and asynchronous circuits
5. To introduce digital simulation techniques for development of application oriented logic Circuit

UNIT - I NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES 9

Number system, error detection, corrections & codes conversions, Boolean algebra: DeMorgan's theorem, switching functions and minimization using K-maps & Quine McCluskey method - Digital Logic Families -comparison of RTL, DTL, TTL, ECL and MOS families -operation, characteristics of digital logic family.

UNIT - II COMBINATIONAL CIRCUITS 9

Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps - simplification and implementation of combinational logic – multiplexers and de multiplexers - code converters, adders, subtractors, Encoders and Decoders.

UNIT - III SYNCHRONOUS SEQUENTIAL CIRCUITS 9

Sequential logic- SR, JK, D and T flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits -Up-Down Counters, Ripple counter, state diagram; state reduction; state assignment with examples.

UNIT - IV ASYNCHRONOUS SEQUENTIAL CIRCUITS AND PROGRAMMABILITY LOGIC DEVICES 9

Transition stability, flow stability-race conditions, hazards & errors in digital circuits; analysis of asynchronous sequential logic circuits introduction to Programmability Logic Devices: PROM – PLA -PAL, CPLD-FPGA.

RTL Design - combinational logic - Sequential circuit - Operators - Introduction to Packages - Subprograms - Test bench. (Simulation /Tutorial Examples: adders, counters, flip flops, Multiplexers & De multiplexers).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Explain various number systems and characteristics of digital logic families.
2. Apply K-maps and Quine McCluskey methods to simplify the given Boolean Expressions and to explain the implementation of various combinational logic circuits.
3. Design of various synchronous logic circuits using Flip Flops.
4. Explain asynchronous sequential circuits and programmable logic devices.
5. Use VHDL for simulating and testing RTL, combinatorial and sequential circuits.

TEXT BOOKS:

1. Morris Mano.M, 'Digital Logic and Computer Design', Prentice Hall of India, 3rd Edition, 2005.
2. Donald D.Givone, 'Digital Principles and Design', Tata McGraw Hill, 1st Edition, 2003.
3. Thomas L Floyd, 'Digital fundamentals', Pearson Education Limited, 11th Edition, 2018.

REFERENCES:

1. Tocci R.J., Neal S. Widmer, 'Digital Systems: Principles and Applications', Pearson Education Asia, 12th Edition, 2017.
2. Donald P Leach, Albert Paul Malvino, Goutam Sha, 'Digital Principles and Applications', Tata McGraw Hill, 7th Edition, 2010.

CO - PO and CO - PSO MAPPING

EE3361	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-
CO2	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-
CO3	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-
CO4	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-
CO5	3	3	3	1	3	-	-	-	-	-	-	1	3	-	1	-
Average	3.0	3.0	3.0	1.0	3.0	-	-	-	-	-	-	1.0	3.0	-	1.0	-

COURSE OBJECTIVES

1. To understand the concept of electromechanical energy conversion system.
2. To identify the appropriate machine for a given application based on its characteristics and parallel operation of generators.
3. To identify the appropriate test to determine the performance parameters of a given machine.
4. To familiarize with the working of single-phase transformer, finding the equivalent circuit and parallel operation of transformers.
5. To deliberate the working of auto transformer and three phase transformers.

UNIT - I ELECTROMECHANICAL ENERGY CONVERSION**9**

Fundamentals of Magnetic circuits- Statically and dynamically induced EMF - Principle of electromechanical energy conversion forces and torque in magnetic field systems- energy balance in magnetic circuits- magnetic force- co-energy in singly excited and multi excited magnetic field system- mmf of distributed windings – Winding Inductances-, magnetic fields in rotating machines- magnetic saturation and leakage fluxes. Introduction to Indian Standard Specifications (ISS) - Role and significance in testing.

UNIT - II DC GENERATORS**9**

Principle of operation, constructional details, armature windings and its types, EMF equation, wave shape of induced emf, armature reaction, demagnetizing and cross magnetizing Ampere turns, compensating winding, commutation, methods of improving commutation, interpoles, OCC and load characteristics of different types of DC Generators. Parallel operation of DC Generators, equalizing connections- applications of DC Generators.

UNIT - III DC MOTORS**9**

Principle of operation, significance of back emf, torque equations and power developed by armature, speed control of DC motors, starting methods of DC motors, load characteristics of DC motors, losses and efficiency in DC machine, condition for maximum efficiency. Testing of DC Machines: Brake test, Swinburne's test, Hopkinson's test, Field test, Retardation test, Separation of core losses-applications of DC motors.

UNIT - IV SINGLE PHASE TRANSFORMER**9**

Construction and principle of operation, equivalent circuit, phasor diagrams, testing - polarity test, open circuit and short circuit tests, voltage regulation, losses and efficiency, all day efficiency, back-to-back test, separation of core losses, parallel operation of single-phase transformers, excitation phenomenon in transformers, applications of single-phase transformer.

UNIT - V AUTOTRANSFORMER AND THREE PHASE TRANSFORMER**9**

Construction and working of auto transformer, comparison with two winding transformers, applications of autotransformer. Three Phase Transformer- Construction, types of connections and their comparative features, Scott connection, applications of Scott connection tap changing transformers.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

Upon the successful completion of the course, students will have the:

1. Apply the laws governing the electromechanical energy conversion for singly and multiple excited systems.
2. Explain the construction and working principle and various characteristics of DC generator.
3. Compute various performance parameters of the machine, by conducting suitable tests.
4. Draw the equivalent circuit of transformer and predetermine the efficiency and regulation.
5. Describe the working principle of auto transformer, three phase transformer with different types of connections.

TEXTBOOKS

1. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2. P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.

REFERENCE BOOKS

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Edition.
2. P.C. Sen "Principles of Electric Machines and Power Electronics" John Wiley & Sons; 3rd Edition 2013.
3. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", Pearson Education., (5th Edition), 2002.
4. M. G. Say, "Performance and design of AC machines", CBS Publishers, First Edition 2008.
5. S.K. Bhattacharya, "Electrical Machines" McGraw - Hill Education, New Delhi, 3rd Edition, 2009.

CO - PO and CO - PSO MAPPING

EE3362	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	1	1	1	-	-	-	-	-	-	-	2	2	-	-
CO2	3	3	1	1	1	-	-	-	-	-	-	-	2	2	-	-
CO3	3	3	1	1	1	-	-	-	-	-	-	-	2	2	-	-
CO4	3	3	1	1	1	-	-	-	-	-	-	-	2	2	-	-
CO5	3	3	1	1	1	-	-	-	-	-	-	-	2	2	-	-
Average	3.0	3.0	1.0	1.0	1.0	-	-	-	-	-	-	-	2.0	2.0	-	-

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), DhanpatRai & 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

EE3363	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	1	1	1	-	-	-	-	-	-	-	2	2	-	-
CO2	3	3	1	1	1	-	-	-	-	-	-	-	2	2	-	-
CO3	3	3	1	1	1	-	-	-	-	-	-	-	2	2	-	-
CO4	3	3	1	1	1	-	-	-	-	-	-	-	2	2	-	-
CO5	3	3	1	1	1	-	-	-	-	-	-	-	2	2	-	-
Average	3.0	3.0	1.0	1.0	1.0	-	-	-	-	-	-	-	2.0	2.0	-	-

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

COURSE OBJECTIVES:

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

UNIT - I	PN JUNCTION DEVICES	9

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

UNIT - II BJT AND SMALL SIGNAL AMPLIFIERS 9

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

UNIT - III FIELD EFFECT TRANSISTORS AND THYRISTORS 9

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

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Explain the operation and characteristics of Semiconductor Diodes.
2. Formulate the expression for voltage gain, current gain, input resistance and output resistance of BJT CE,CB and CC amplifier using h-parameter model.
3. Formulate the expression for voltage gain, input resistance and output resistance of FET amplifier under CS,CG and CD and operation of Thyristor.
4. Explain the operation of differential amplifier, single tuned amplifier and power amplifiers.
5. Analyze the operation of negative feedback amplifiers and to design RC and LC tuned Oscillators for a given frequency range.

TEXT BOOKS:

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

REFERENCES:

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

CO - PO and CO - PSO MAPPING

EI3361	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	1	1	-	-	-	1		1	-	-	1	-	-	2
CO2	3	3	3	3	-	-	-	1		1	-	-	1	-	-	3
CO3	3	3	3	3	-	-	-	1		1	-	-	1	-	-	1
CO4	2	2	1	1	-	-	-	1		1	-	-	2	-	-	2
CO5	3	3	3	2	-	-	-	1		1	-	-	1	-	-	2
Average	2.6	2.6	2.2	2.0	-	-	-	1.0		1.0	-	-	1.2	-	-	2.0

EE3364	ELECTRICAL MACHINES LABORATORY - I	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

To impart knowledge on the following topics

- To expose the students to the operation of D.C. machines.
- To expose the students to the operation of transformers.
- To expose the students to the operation of generators.
- To impart knowledge about open circuit and load characteristics.
- To impart knowledge about performance characteristics.

LIST OF EXPERIMENTS

- 1 Open circuit and load characteristics of DC shunt generator- critical resistance and critical speed.
- 2 Load characteristics of DC compound generator with differential and cumulative connections.
- 3 Load test on DC shunt motor.
- 4 Load test on DC compound motor.
- 5 Load test on DC series motor.
- 6 Swinburne's test and speed control of DC shunt motor.
- 7 Hopkinson's test on DC motor - generator set.
- 8 Load test on single-phase transformer and three phase transformers.
- 9 Open circuit and short circuit tests on single phase transformer.
- 10 Sumpner's test on single phase transformers.
- 11 Separation of no-load losses in single phase transformer.
- 12 Study of starters and 3-phase transformers connections.
- 13 Measurement Observation of switching transients in single phase transformer (Magnetic Inrush current of Transformers).
- 14 Polarity Test on single phase transformer

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Ability to understand and analyze DC Generator.
2. Ability to understand and analyze DC Motor.
3. Ability to understand and analyze Transformers.
4. Ability to understand the performance characteristics.
5. Ability to understand the starters.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1	DC Shunt Motor with Loading Arrangement	3
2	DC Shunt Motor Coupled with Three phase Alternator	1
3	Single Phase Transformer	6
4	DC Series Motor with Loading Arrangement	1
5	DC compound Motor with Loading Arrangement	1
6	DC Shunt Motor Coupled with DC Compound Generator	1
7	DC Shunt Motor Coupled with DC Shunt Generator	2
8	Tachometer-Digital/Analog	15
9	Single Phase Auto Transformer	4
10	Three Phase Auto Transformer	1
11	Single Phase Resistive Loading Bank	3
12	Three Phase Resistive Loading Bank	1
13	All type of AC and DC Starters	1 Each

CO - PO and PSO MAPPING

EE3364	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	1	-	-	-	-	-	-	-	1	2	2	-	-
CO2	3	3	-	1	-	-	-	-	-	-	-	1	2	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	2	2	2	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	1	2	2	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	1	2	2	-	-
Average	3.0	3.0	2.0	1.3	-	-	-	-	-	-	-	1.2	2.0	2.0	-	-

COURSE OBJECTIVES

- To simulate various electric circuits using Pspice / Matlab/e-Sim / Scilab
- To gain practical experience on electric circuits and verification of theorems.
- To gain practical experience on frequency response of RC and RLC circuit.
- To gain practical experience on two port networks.
- To simulate and gain practical experience on 3 phase balanced circuit.

LIST OF EXPERIMENTS

- 1 Simulation and experimental verification of electrical circuit problems using Kirchhoff's voltage and current laws.
- 2 Simulation and experimental verification of electrical circuit problems using Thevenin's theorem.
- 3 Simulation and experimental verification of electrical circuit problems using Norton's theorem.
- 4 Simulation and experimental verification of electrical circuit problems using Superposition theorem.
- 5 Simulation and experimental verification of Maximum Power transfer Theorem.
- 6 Study of Analog and digital oscilloscopes and measurement of sinusoidal voltage, frequency and power factor.
- 7 Simulation and Experimental validation of R-C electric circuit transients.
- 8 Simulation and Experimental validation of frequency response of RLC electric circuit.
- 9 Design and Simulation of series resonance circuit.
- 10 Design and Simulation of parallel resonant circuits.
- 11 Simulation of three phase balanced and unbalanced star, delta networks circuits.

- 12 Simulation and experimental verification of Millman's theorem.
- 13 Determination of Z and Y parameters of a Two - Port networks.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to Understand and apply circuit theorems and concepts in engineering applications.
2. Ability to Simulate electric circuits.
3. Ability to understand concept of frequency response of the systems.
4. Ability to understand concept of 3 phase balanced circuit
5. Ability to understand concept of 3 phase un-balanced circuit

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1	Regulated Power Supply: 0 - 15 V D.C	10
2	Function Generator (1 MHz)	10
3	Single Phase Energy Meter	01
4	Oscilloscope (20 MHz)	10
5	Digital Storage Oscilloscope (20 MHz)	1
6	PC	10
7	Circuit Simulation Software (e-Sim/ Scilab/ Pspice / MATLAB / other Equivalent software Package)	Min.10 Users
8	Printer	1
9	AC/DC - Voltmeters	10
10	Ammeters	10
11	Multi-meters	10
12	Single Phase Wattmeter	3
	Decade Resistance Box, Decade Inductance Box, Decade	6 Nos.
13	Capacitance Box	each

14 Circuit Connection Boards

10

15 Resistors, Inductors, Capacitors of various capacities (Quarter Watt to 10 Watt)

As
Required

CO - PO and PSO MAPPING

EE3365	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	-	-	2		3	-	-	-	1	-	-	-
CO2	-	1	-	-	1	-	-	-	-	-	2	-	-	2	2	-
CO3	1		-	1	-	-	3	2	-	-	2	-	-	2	-	3
CO4	-	1	-	-	-	-	-	-	-	-	-	3	-	-	2	-
CO5	-	-	1	-	1	-	-	2	3	-	-	-	-	3	-	-
Average	1.0	1.0	1.0	1.0	1.0	-	2.5	2.0	3.0	-	2.0	3.0	1.0	2.3	2.0	3.0

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

COURSE OBJECTIVES:

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

LIST OF EXPERIMENTS

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Determine the Breakdown voltage, forward and reverse resistance of PN junction diode and Zener diode and Calculate the ripple factor of rectifier circuits with filters.
2. Analyze the characteristics of BJT under CE and CB configuration.
3. Obtain the UJT, SCR and JFET parameters from the characteristics.
4. Calculate the gain of differential amplifier using FET.
5. Design the RC and LC tuned oscillators for a given oscillating frequency and develop feedback amplifiers.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl. No.	Description of Equipment	Required numbers (for batch of 30 students)
1.	Regulated Power Supply - Dual, 0-30V, variable	10
2.	Cathode Ray Oscilloscope, 0-30 MHz	8
3.	Digital Multimeter	10
4.	Function Generator, 0 - 20 MHz	8
5.	Breadboard	10
6.	PN Junction diode - 1N4007	20
7.	Zener diode - FZ5.6 / FZ9	10
8.	Photo diode - S7184	10
9.	BJT - BC107 / BC547	10
10.	JFET - BFW10 / BFW11	10
11.	UJT - 2N2646	10
12.	SCR - 2N2324	10
13.	Step-down transformer - 230V/12-0-12V	10
14.	Capacitors, assorted	10 each

15.	Resistors 1/4W, assorted	10 each
16.	Single-strand wires, different colours	10 each
17.	MATLAB Software	Few Licenses

CO - PO and CO - PSO MAPPING

EI3365	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	1
CO2	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	2
CO3	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	1
CO4	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	1
CO5	3	2	1	-	-	2	-	2	2	1	-	-	-	-	-	2
Average	3.0	2.0	2.0	-	-	2.0	-	2.0	2.0	1.0	-	-	-	-	-	1.4

SEMESTER – IV

MA3423	APPLIED MATHEMATICS FOR ELECTRICAL AND INSTRUMENTATION ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

1. To develop the students with ordinary differential equations
2. To develop the use of ordinary differential equations that is needed by engineers for practical application.
3. To develop an understanding of standard techniques of complex variables theory in practical analytic function.
4. To develop an understanding of standard techniques of complex variable theory for conformal mapping.
5. To familiarize the students of complex integration technique and contour integration technique which can be used in real integrals.

UNIT - I ORDINARY DIFFERENTIAL EQUATIONS 6

Higher order linear differential equations with constant coefficients - Method of variation of parameters.

UNIT - II APPLICATION OF ORDINARY DIFFERENTIAL EQUATIONS 6

Solution of ODE related to electric circuits, motion of a particle in a resisting medium and simple harmonic motion.

UNIT - III ANALYTIC FUNCTIONS 6

Analytic functions - Necessary and sufficient conditions for analyticity in Cartesian coordinates - Properties - Harmonic conjugates - Construction of analytic function.

UNIT - IV CONFORMAL MAPPING 6

Conformal mapping – Mapping by functions $w = z+c$, $w = cz$ and $w = 1/z$ – Bilinear transformation.

Cauchy's integral theorem - Cauchy's integral formula - Singularities - Residues - Cauchy's Residue theorem - Applications of circular contour (with poles NOT on real axis).

TOTAL: 30 PERIODS

COURSE OUTCOMES

1. Understand how to solve the given ordinary differential equations.
2. Solve differential equations using Fourier series analysis which plays a vital role in engineering applications.
3. To develop an understanding of the standard techniques of complex variable theory in particular analytic function.
4. To familiarize the students with conformal mapping.
5. To familiarize the students with complex integration techniques and contour integration techniques which can be used in real integrals.

TEXTBOOKS

1. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
2. Narayanan.S, Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S. Viswanathan Publishers Pvt. Ltd.,1998.

REFERENCE BOOKS

1. Ramana.B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
4. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt. Ltd., Sixth Edition, New Delhi, 2012.

CO - PO and CO - PSO MAPPING

MA3423	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	3	1	2	1	-	-	-	-	-	-	-	1	-	-	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	1	-	-	-	-
CO5	3	1	1	1	-	-	-	-	-	-	-	1	-	-	-	-
Average	3.0	1.6	1.4	1.0	-	-	-	-	-	-	-	1.0	-	-	-	-

OBJECTIVES:

1. To learn IC classification, basic building blocks and characteristics of linear integrated circuits.
2. To learn and design the linear and non-linear applications of operational amplifiers.
3. To introduce the theory and applications of analog multipliers, PLL and VCO.
4. To learn the theory of ADC and DAC .
5. To introduce 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, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Comparators, Multivibrator, 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, Operation of the basic PLL, closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application 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, Multivibrators and Triangular wave generator, Saw-tooth wave generator, IC555 Timer, IC Voltage regulators, IC 723 general purpose regulator, Frequency to Voltage and Voltage to Frequency converters, Isolation Amplifier.

TOTAL : 45 Periods

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

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

TEXT BOOKS:

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.

CO - PO and CO - PSO MAPPING

EC3462	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	3	2	-	-	-	-	1	2	2	1	1	1
CO2	3	2	2	3	2	1	-	-	-	-	1	2	2	1	1	1
CO3	3	2	3	2	2	2	-	-	-	-	1	1	2	1	1	1
CO4	3	2	2	2	3	1	-	-	-	-	1	1	2	1	1	1
CO5	2	2	3	2	3	2	-	-	-	-	1	1	2	1	1	1
Average	2.8	2.2	2.6	2.4	2.6	1.6	-	-	-	-	1.0	1.4	2.0	1.0	1.0	1.0

COURSE OBJECTIVES:

1. To understand the use of transfer function models for analysis physical systems and introduce the control system components.
2. To provide adequate knowledge in the time response of systems and steady state error analysis.
3. To accord basic knowledge in obtaining the open loop and closed-loop frequency responses of systems.
4. To introduce stability analysis for systems design of Compensator.
5. State variable representation of physical systems.

UNIT - I SYSTEMS AND REPRESENTATION 9

Basic elements in control systems: - Open and closed loop systems - Electrical analogy of mechanical system- Transfer function - AC and DC servomotors - Synchro - Block diagram reduction techniques - Signal flow graphs.

UNIT - II TIME RESPONSE 9

Time response: - Time domain specifications - Types of test input - I and II order system response - Error coefficients - Generalized error series - Steady state error -Effects of P, PI, PID modes of feedback control -Time response analysis.

UNIT - III FREQUENCY RESPONSE 9

Frequency response: - Bode plot - Polar plot - Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications.

UNIT - IV STABILITY 9

Characteristics equation - Location of roots in S plane for stability - Routh Hurwitz criterion - Root locus construction - Effect of pole, zero addition - Gain margin and phase margin - Nyquist stability criterion. Design of Lead-Lag controllers using Bode plots.

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 Pvt. Ltd., 2021.
2. Benjamin C. Kuo, " Automatic Control systems", Wiley Eastern, 2014.

REFERENCES:

1. M.Gopal, "Control System: Principle and design", McGraw Hill Education, 2012.
2. Katsuhiko Ogata, "Modern Control Engineering", Pearson Education, 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.

CO - PO and CO - PSO MAPPING

EI3464	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	-	-	-	3	-	3	-	1	1	-	-	2
CO2	3	3	3	2	-	-	-	3	-	3	-	1	2	-	-	3
CO3	2	1	2	1	-	-	-	2	-	2	-	1	1	-	-	1
CO4	3	3	3	2	-	-	-	3	-	3	-	1	2	-	-	2
CO5	3	3	3	3	-	-	-	3	-	3	-	1	1	-	-	1
Average	2.8	2.6	2.8	2.2	-	-	-	2.8	-	2.8	-	1.0	1.4	-	-	1.8

COURSE OBJECTIVES

To impart knowledge on the following topics

1. Construction, principle of operation and performance of induction machines.
2. Starting and speed control of three-phase induction motors.
3. Construction and performance of salient and non-salient type synchronous generators.
4. Principle of operation and performance of synchronous motor.
5. Construction, principle of operation and performance of single phase induction motors and special machines.

UNIT - I	THREE PHASE INDUCTION MOTOR	9

Constructional details -magnetic fields in rotating machines- Types of rotors - Principle of operation - Slip - cogging and crawling - Equivalent circuit - Torque-Slip characteristics - Condition for maximum torque - Losses and efficiency - Load test - No load and blocked rotor tests - Circle diagram – Separation of losses – Double cage induction motors – Induction generators - Synchronous induction motor.

UNIT - II	STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR	9

Need for starting - Types of starters - DOL, Rotor resistance, Autotransformer and Star - delta starters - Speed control - Voltage control, Frequency control and pole changing - Cascaded connection - V/f control - Slip power recovery scheme -Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT - III SYNCHRONOUS GENERATOR 9

Constructional details - Types of rotors - winding factors - emf equation - Synchronous reactance – Armature reaction – Phasor diagrams of non salient pole synchronous generator connected to infinite bus - Synchronizing and parallel operation - Synchronizing torque - Change of excitation and mechanical input - Voltage regulation - EMF, MMF, ZPF and A.S.A methods - steady state power-angle characteristics - Two reaction theory - slip test -short circuit transients -Capability Curves.

UNIT - IV SYNCHRONOUS MOTOR**9**

Principle of operation - Torque equation - Operation on infinite bus bars - V and Inverted V curves - Power input and power developed equations - Starting methods - Current loci for constant power input, constant excitation and constant power developed - Hunting - natural frequency of oscillations - damper windings - synchronous condenser.

**UNIT - V SINGLE PHASE INDUCTION MOTORS AND SPECIAL
MACHINES****9**

Constructional details of single phase induction motor - Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test -Performance analysis – Starting methods of single-phase induction motors -Capacitor-start capacitor run Induction motor - Shaded pole induction motor - Linear induction motor – Repulsion motor - Hysteresis motor - AC series motor - Servo motors - Stepper motors - introduction to magnetic levitation systems - DC Linear Motor - Linear Synchronous Motor.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

Upon the successful completion of the course, students will have the:

1. Ability to understand the construction and working principle of Three phase Induction Motor.
2. Acquire knowledge about the starting and speed control of induction motors.
3. Ability to understand the construction and working principle of Synchronous generator
4. Ability to understand the construction and working principle of Synchronous Motor.
5. To gain knowledge about the basic principles and working of Single phase induction motors and Special Electrical Machines.

TEXTBOOKS

1. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, “Electric Machinery”, McGraw Hill publishing Company Ltd., 6th Edition 2017.
2. Stephen J. Chapman, “Electric Machinery Fundamentals” 4th Edition, McGraw Hill Education Pvt. Ltd., 2017.

3. D.P. Kothari and I.J. Nagrath, "Electric Machines", McGraw Hill Publishing Company Ltd., 5th Edition 2017.
4. P.S. Bhimbhra, "Electrical Machinery", Khanna Publishers, 2nd Edition, 2021.

REFERENCE BOOKS

1. Vincent Del Toro, "Basic Electric Machines", Pearson India Education, 2016.
2. M.N. Bandyopadhyay, "Electrical Machines Theory and Practice", PHI Learning Pvt. Ltd., New Delhi, 2011.
3. B.R.Gupta, "Fundamental of Electric Machines", New Age International Publishers, 3rd Edition, Reprint 2015.
4. Murugesh Kumar, "Electric Machines", Vikas Publishing House Pvt. Ltd., First Edition 2010.
5. Alexander S. Langsdorf, "Theory of Alternating-Current Machinery", McGraw Hill Publications, 2001.

CO - PO and CO - PSO MAPPING

EE3461	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	1	1	1	-	-	-	-	-	-	-	3	3	-	-
CO2	3	3	1	1	1	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	1	1	1	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	1	1	1	-	-	-	-	-	-	-	3	3	-	-
CO5	3	3	1	1	1	-	-	-	-	-	-	-	3	3	-	-
Average	3.0	3.0	1.0	1.0	1.0	-	-	-	-	-	-	-	3.0	3.0	-	-

COURSE OBJECTIVES

1. The structure of electric power system and to develop expressions for the computation of transmission line parameters.
2. The equivalent circuits for the transmission lines based on distance and to determine voltage regulation and efficiency.
3. The mechanical design of transmission lines and to analyze the voltage distribution in insulator strings to improve the efficiency.
4. The types and construction of cables and methods to improve the efficiency.
5. To study about distribution systems, types of substations, methods of grounding, EHVAC, HVDC and FACTS.

UNIT - I TRANSMISSION LINE PARAMETERS**9**

Structure of Power System - Parameters of single and three phase transmission lines with single and double circuits - Resistance, inductance and capacitance of solid, stranded and bundled conductors, Symmetrical and unsymmetrical spacing and transposition - application of self and mutual GMD; skin and proximity effects - Typical configurations, conductor types and electrical parameters of EHV lines. Interference with Neighboring Communication circuits.

UNIT - II MODELLING AND PERFORMANCE OF TRANSMISSION LINES**9**

Performance of Transmission lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, surge impedance - transmission efficiency and voltage regulation, real and reactive power flow in lines - Power Circle diagrams - Formation of Corona – Critical Voltages – Effect on Line Performance.

UNIT - III MECHANICAL DESIGN OF LINES**9**

Mechanical design of OH lines – Line Supports – Types of towers – Stress and Sag Calculation – Effects of Wind and Ice loading. Insulators: Types, voltage distribution in insulator string, improvement of string efficiency, testing of insulators. Standards for testing of Insulators.

UNIT - IV UNDER GROUND CABLE**9**

Underground cable - Types of cable – Construction of single core and 3 core Cables - Insulation Resistance - Potential Gradient - Capacitance of Single-core and 3 core cables - Grading of cables - Power factor and heating of cables - DC cables.

UNIT - V DISTRIBUTION SYSTEMS**9**

Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions - Techniques of Voltage Control and Power factor improvement - Distribution Loss - Types of Substations - Methods of Grounding - Trends in Transmission and Distribution: EHVAC, HVDC and FACTS (Qualitative treatment only). Decentralized power systems.

TOTAL: 45 PERIODS**COURSE OUTCOMES**

1. To acquire knowledge on importance and the functioning of transmission line parameters.
2. To acquire knowledge on the performance of Transmission lines.
3. To understand the concepts of Lines and Insulators.
4. To acquire knowledge on Underground Cables.
5. To understand the importance of distribution of the electric power in power system and to become familiar with the function of different components used in T&D systems.

TEXTBOOKS

1. S.N. Singh, "Electric Power Generation, Transmission and Distribution", Prentice Hall of India Pvt. Ltd, New Delhi, Second Edition, 2011.
2. C. L. Wadhwa, "Electrical Power Systems", New Academic Science Ltd, 2009.
3. D. P. Kothari, I.J. Nagarath, "Power System Engineering", Mc Graw-Hill Publishing Company limited, New Delhi, Second Edition, 2008.

REFERENCE BOOKS

1. B.R.Gupta, "Power System Analysis and Design" S. Chand, New Delhi, Fifth Edition, 2008.
2. Luces M.Fualken berry, Walter Coffe, "Electrical Power Distribution and Transmission", Pearson Education, 2007.
3. Arun Ingole, "power transmission and distribution" Pearson Education, 2017
4. Brian, Hardy and Colin R.Bayliss "Transmission and Distribution in Electrical Engineering", Newnes; Fourth Edition, 2012
5. G.Ramamurthy, "Handbook of Electrical Power Distribution," Universities Press, 2013
6. V.K.Mehta, Rohit Mehta, "Principles of Power System", S. Chand & Company Ltd., New Delhi, 2013.

CO - PO and CO - PSO MAPPING

EE3462	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	3	-	-	1	-	-	-	-	2	3	3	-	-
CO2	3	3	2	3	-	-	1	-	-	-	-	2	3	3	-	-
CO3	3	3	2	3	-	-	1	-	-	-	-	2	3	3	-	-
CO4	3	3	2	3	-	-	1	-	-	-	-	2	3	3	-	-
CO5	3	3	2	3	-	-	1	-	-	-	-	2	3	3	-	-
Average	3.0	3.0	2.0	3.0	-	-	1.0	-	-	-	-	2.0	3.0	3.0	-	-

COURSE OBJECTIVES

1. To expose the knowledge on testing techniques with international standards.
2. To educate the fundamental concepts and characteristics of measurement and errors
3. To impart the knowledge on the functional aspects of measuring instruments.
4. To infer the importance of various bridge circuits used with measuring instruments
5. To educate the fundamental working of sensors and transducers and their applications with the knowledge on digital instrumentation principles.

UNIT - I CONCEPTS OF MEASUREMENTS 9

Instruments: classification, applications - Elements of a generalized measurement system - Static and dynamic characteristics - Errors in measurement -Statistical evaluation of measurement data.

UNIT - II MEASUREMENT OF PARAMETERS IN ELECTRICAL SYSTEMS 9

Classification of instruments – moving coil and moving iron meters – Induction type, dynamometer type watt meters - Energy meter - Megger - Instrument transformers (CT & PT).

UNIT - III AC/DC BRIDGES AND INSTRUMENTATION AMPLIFIERS 9

Wheatstone bridge, Kelvin double bridge - Maxwell, Hay, Wien and Schering bridges – Errors and compensation in A.C. bridges - Instrumentation Amplifiers.

UNIT - IV TRANSDUCERS FOR MEASUREMENT OF NON-ELECTRICAL PARAMETERS 9

Classification of transducers - Measurement of pressure, temperature, displacement, flow, angular velocity - Digital transducers - Smart Sensors.

UNIT - V DIGITAL INSTRUMENTATION 9

A/D converters: types and characteristics – Sampling, Errors- Measurement of voltage, Current, frequency and phase - D/A converters: types and characteristics- DSO- Data Loggers – Basics of PLC programming and Introduction to Virtual Instrumentation - Instrument standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. To acquire knowledge on fundamental art of measurement in engineering.
2. To understand the concepts of structural elements of various instruments.
3. Ability to the importance of bridge circuits.
4. To acquire knowledge about various transducers and their characteristics by experiments.
5. To understand the concept of digital instrumentation and virtual instrumentation by experiments.

TEXT BOOKS

1. A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", Dhanpat Rai and Co., 2015.
2. J. B. Gupta, "A Course in Electronic and Electrical Measurements", S. K. Katson & Sons, Delhi, 2013.
3. Doebelin E.O. and Manik D.N., "Measurement Systems – Applications and Design", Special Indian Edition, McGraw Hill Education Pvt. Ltd., 7th Edition, 2019.

REFERENCE BOOKS

1. H.S. Kalsi, "Electronic Instrumentation", McGraw Hill, 4th Edition, 2019.
2. D.V.S. Murthy, "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd., 2015.
3. David Bell, "Electronic Instrumentation & Measurements", Oxford University Press, 2013.
4. Martin Reisland, "Electrical Measurements", New Age International (P) Ltd., Delhi, 2001.
5. Alan. S. Morris, "Principles of Measurements and Instrumentation", 2nd Edition, Prentice Hall of India, 2003.

CO - PO and CO - PSO MAPPING

EE3463	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	-	3	2	-	2	-	-	-	3	3	3	3	-
CO2	3	2	3	2	-	-	-	-	-	3	-	3	3	3	3	-
CO3	3	2	3	-	3	2	-	-	-	-	-	3	3	3	3	-
CO4	3	2	3	-	-	-	-	2	-	-	-		3	3	3	-
CO5	3	2	3	2	3	-	-	-	-	3	-	3	3	3	3	-
Average	3.0	2.0	3.0	2.0	3.0	2.0	-	2.0	-	3.0	-	3.0	3.0	3.0	3.0	-

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.K. Gupta's NCC Handbook of NCC Cadets 'A', 'B' and 'C' certificate Examinations, 2023.

Reference book:

1. V. B. RAO, Personality Development and Soft Skills, BS Publications, 2020.
2. Harish K. Gupta, Disaster Management, Universities press, 2003.

EE3464	ELECTRICAL MACHINES LABORATORY - II	L	T	P	C
		0	0	3	1.5

COURSE OBJECTIVES

To impart knowledge on the following topics

- To expose the students to the operation of synchronous machines.
- To impart knowledge on voltage regulation of alternators.
- To expose the students to the operation of induction motors.
- To impart knowledge on equivalent circuit of the induction motors.
- To impart knowledge on necessity of starters.

LIST OF EXPERIMENTS

- 1 Load test on three-phase induction motor.
- No load and blocked rotor tests on three-phase induction motor
- 2 (Determination of equivalent circuit parameters).
- 3 Load test on single-phase induction motor.
- 4 No load and blocked rotor test on single-phase induction motor.
- 5 Separation of No-load losses of three-phase induction motor.
- 6 Regulation of three phase alternator by EMF and MMF methods.
- 7 Regulation of three phase alternator by ZPF and ASA
- 8 Regulation of three phase salient pole alternator by slip test.
- 9 Measurements of negative sequence and zero sequence impedance of alternators.
- 10 V and Inverted V curves of Three Phase Synchronous Motor.
- 11 Study of Induction motor Starters.
- 12 Synchronization of Alternator.
- 13 Determination of Circle Diagram of three phase induction motor.

TOTAL : 45 PERIODS

COURSE OUTCOMES

1. Ability to understand and analyze EMF and MMF methods
2. Ability to analyze the characteristics of V and Inverted V curves.
3. Acquire hands on experience of conducting various tests on alternators and obtaining their performance indices using standard analytical as well as graphical methods to understand the importance of Synchronous machines
4. Acquire hands on experience of conducting various tests on single and three phase Induction motors and obtaining their performance indices using standard analytical as well as graphical methods to understand the importance of single and three phase Induction motors
5. Ability to acquire knowledge on separation of losses.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS

1	Synchronous Induction motor 3HP	1
2	DC Shunt Motor Coupled with Three phase Alternator	4
3	DC Shunt Motor Coupled with Three phase Slip ring Induction motor	1
4	Three Phase Induction Motor with Loading Arrangement	2
5	Single Phase Induction Motor with Loading Arrangement	2
6	Tachometer-Digital/Analog	8
7	Single Phase Auto Transformer	2
8	Three Phase Auto Transformer	3
9	Single Phase Resistive Loading Bank	2
10	Three Phase Resistive Loading Bank	2
11	Capacitor Bank	1

CO - PO and CO - PSO MAPPING

EE3464	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	1	-	-	-	-	-	-	-	1	2	2	-	-
CO2	3	3	-	1	-	-	-	-	-	-	-	1	2	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	2	2	2	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	1	2	2	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	1	2	2	-	-
Average	3.0	3.0	2.0	1.3	-	-	-	-	-	-	-	1.2	2.0	2.0	-	-

COURSE OBJECTIVES:

1. To learn about the characteristics of sensors for the different measurement applications.
2. To demonstrate the measurement of Resistance, Inductance and Capacitance using Bridge Circuits.
3. To expose the students to understand signal conditioning circuits for the measurement of temperature.
4. To demonstrate the calibration of power and energy measurement.
5. To impart knowledge about analog to digital and digital to analog converters.

LIST OF EXPERIMENTS:

1. Study of Displacement and Pressure Transducers.
2. Characteristics of Light sensors-Photo diode, Photo transistor.
3. DC Bridges-Wheat stone bridge and Kelvin's bridge.
4. AC Bridges-Maxwell's bridge, Anderson's bridge and Schering bridge.
5. Instrumentation Amplifier.
6. Measurement of strain using Load cell.
7. Calibration of Wattmeter.
8. Calibration of Single Phase Energy Meter.
9. Measurement of skin temperature-Contact and Non contact method.
10. Study the Characteristics of Temperature Sensors.
11. Characteristics of A/D Converter.
12. Characteristics of A/D Converter

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1. Displacement Measurement Trainer Kit	2
2. Pressure Transducer Kit	1
3. Strain Gauge Module with Cantilever Beam	1

4. Wheat Stone Bridge	2
5. Kelvin's Bridge	2
6. Maxwell's Bridge	2
7. Schering Bridge	2
8. Anderson's Bridge	2
9. RTD	1
10. Thermistor	2
11. LDR, Photo Diode, Photo Transistor	5 Each
12. Light Source	3
13. Decade Resistance box, Decade Inductance Box,	
a. Decade Capacitance	3 Each
14. Regulated Power Supply	10
15. CRO	10
16. Analog to Digital and Digital to Analog Converters	1 Each
17. Voltmeter, Ammeter	10 Each
18. Multimeter	5 Each

TOTAL: 45 PERIODS

COURSE OUTCOMES:

1. Ability to understand the characteristics of sensors for measurement applications.
2. Ability to understand the demonstration of Resistance, Inductance, Capacitance Measurement using bridge circuits.
3. Ability to understand signal conditioning circuits for the measurement of Temperature.
4. Ability to understand the calibration of Power and Energy measurement.
5. Ability to understand the analog to digital and digital to analog converters.

REFERENCES:

1. Laboratory Manual prepared by Course Coordinator

CO - PO and CO - PSO MAPPING

EI3465	PROGRAM OUTCOMES												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3		1		-	-	-	-	-	-	1	2	2	-	-
CO2	3	3		1	-	-	-	-				1	2	2	-	-
CO3	3	3	2	2	-	-	-	-	-	-	-	2	2	2	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	1	2	2	-	-
CO5	3	3	-	-	-	-	-	-	-	-	-	1	2	2	-	-
Average	3.0	3.0	2.0	1.3	-	-	-	-	-	-	-	1.2	2.0	2.0	-	-

COURSE OBJECTIVES:

1. To make the students familiarize with various representations of systems.
2. To make the students analyze the stability of linear systems in the time domain and frequency domain.
3. To make the students design compensator based on the time and frequency domain Specifications.
4. To develop linear models mainly state variable model and transfer function model.
5. To make the students to design a complete closed loop control system for the physical systems.

LIST OF EXPERIMENTS:

1. Simulation of Control Systems by Mathematical development tools.
2. Synchro Transmitter and Receiver Characteristics.
3. Mathematical modeling and simulation of physical systems in at least two fields.
 1. Mechanical
 2. Electrical
 3. Chemical process
4. Determination of Transfer function of Self and Separately excited DC Shunt Generator.
5. Determination of Transfer function of Armature and Field control DC Shunt Motor.
6. Stability analysis using Pole zero maps and Routh Hurwitz Criterion in simulation platform.
7. Root Locus based analysis in simulation platform.
8. Determination of transfer function of a physical system using frequency response and Bode's asymptotes.
9. Design of Lag, lead compensators and evaluation of closed loop performance.
10. Design of P,PI, PID controllers and evaluation of closed loop performance.
11. Study of DC Position control system.
12. Test of controllability and observability in continuous and discrete domain in simulation platform.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1. Transfer function of Separately and Self Excited DC Generator	1
2. Transfer function of Armature and Field Control DC Motor	1
3. Transfer of WardLeonard method of Speed control of DC Motor	1
4. Study of Synchros	2
5. Study of DC Position Control System	1
6. Lag, Lead and Lag-Lead Thermistor	1
7. Study of P,PI and PID Controller	1
8. Computers	10
9. MATLAB Software	Few Licenses

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, the students will demonstrate the ability

1. To model and analyze simple physical systems and simulate the performance in analog and digital platform.
2. To design and implement simple controllers in standard forms.
3. To design compensators based on time and frequency domain specifications.
4. To design a complete closed control loop and evaluate its performance for simple physical systems.
5. To analyze the stability of a physical system in both continuous and discrete domains.

CO - PO and CO - PSO MAPPING

EI3469	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	3	-	-	2	-	-	-	2	3	3	3	3
CO2	3	3	3	3	3	-	-	2	-	-	-	2	3	3	3	3
CO3	3	3	3	3	3	-	-	2	-	-	-	2	3	3	3	3
CO4	3	3	3	3	3	-	-	2	-	-	-	2	3	3	3	3
CO5	3	3	3	3	3	-	-	2	-	-	-	2	3	3	3	3
Average	3.0	3.0	3.0	3.0	3.0	-	-	2.0	-	-	-	2.0	3.0	3.0	3.0	3.0

COURSE OBJECTIVES:

1. Impact knowledge on need for operational studies, and to model the power system under steady state operating condition.
2. To understand and apply iterative techniques for power flow analysis.
3. To model and carry out symmetrical short circuit studies on power system.
4. To model and carry out Un-symmetrical short circuit studies on power system.
5. To model and analyze stability problems in power system.

UNIT-I: POWER SYSTEM OVERVIEW**9**

Need for system planning and operational studies - Power scenario in India - Power system components, Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram, Network graph Theory - Bus incidence matrices, Primitive parameters, Formation of bus admittance matrix – Direct inspection method – Singular Transformation method.

UNIT -II: POWER FLOW ANALYSIS**9**

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method – Flow charts – Comparison of methods.

UNIT -III: SYMMETRICAL FAULT ANALYSIS**9**

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) – Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level – Current limiting reactors.

UNIT -IV: UNSYMMETRICAL FAULT ANALYSIS**9**

Symmetrical components - Sequence impedances - Sequence networks – Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG – unsymmetrical fault occurring

at any point in a power system - computation of post fault currents in symmetrical component and phasor domains.

UNIT -V: STABILITY ANALYSIS

9

Classification of power system stability – Rotor angle stability - Power-Angle equation – Steady state stability - Swing equation – Solution of swing equation by step by step method – Swing curve, Equal area criterion - Critical clearing angle and time, Multi-machine stability analysis – modified Euler method.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will:

- CO1. Model power system components and analyze their behavior under steady-state operating conditions using per-unit system and network equations.
- CO2. Perform power flow analysis using iterative techniques such as Gauss-Seidel and Newton-Raphson methods, and interpret the results for system planning and operation.
- CO3. Analyze the impact of various types of short circuits and explain their role in the selection and design of circuit breakers using symmetrical component theory.
- CO4. Model protection schemes and determine the necessary parameters for safeguarding power system components under abnormal operating conditions.
- CO5. Analyze power system stability using dynamic and transient models, and assess system response under various disturbances.

TEXT BOOKS:

- T1. John J. Grainger, William D. Stevenson, Jr, 'Power System Analysis', Mc Graw Hill Education (India) Private Limited, New Delhi, 2017.
- T2. Kothari D.P. and Nagrath I.J., 'Power System Engineering', Tata McGraw-Hill Education, 3rd edition 2019.

REFERENCES:

- R1. Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

- R2. Pai M A, 'Computer Techniques in Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
- R3. J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, 'Power System Analysis & Design', Cengage Learning, Fifth Edition, 2012.
- R4. P. Venkatesh, B. V. Manikandan, A. Srinivasan, S. Charles Raja, "Electrical Power Systems: Analysis, Security and Deregulation" Prentice Hall India (PHI), second edition 2017.
- R5. Gupta B.R., 'Power System - Analysis and Design', S. Chand Publishing, Reissue edition 2005.
- R6. Kundur P., 'Power System Stability and Control', Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013 A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, 'Electric Machinery', Mc Graw Hill publishing Company Ltd, 6th Edition.

Course Articulation Matrix:

EE3561	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	1	1	1		1					2	3	3		
CO2	3	3	1	1	1		1					2	3	3		
CO3	3	3	1	1	1		1					2	3	3		
CO4	3	3	1	1	1		2					2	3	3		
CO5	3	3	1	1	1		1					2	3	3		
Average	3	3	1	1	1		1.2					2	3	3		

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To understand the various applications of power electronic devices for conversion, control and conditioning of the electrical power and to get an overview of different types of power semiconductor devices and their dynamic characteristics.
2. To understand the operation, characteristics and performance parameters of controlled rectifiers
3. To study the operation, switching techniques and basic topologies of DC-DC switching regulators.
4. To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.
5. To study the operation of AC voltage controller and various configurations of AC voltage controller.

UNIT-I: SWITCHING POWER SUPPLIES**9**

MOSFET dynamic behavior - driver and snubber circuits - low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated topologies – resonant converters - switching loss calculations and thermal design.

UNIT-II: INVERTERS**9**

IGBT: Static and dynamic behavior - single phase half bridge and full bridge inverters - VSI : (1 phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques – various harmonic elimination techniques - CSI, Applications - UPS (Uninterruptible Power Supplies), renewable energy generation systems, Grid Interactive Inverter.

UNIT-III: UNCONTROLLED RECTIFIERS**9**

Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier – voltage doubler circuit – distortion factor – capacitor filter for low power rectifiers – LC filters – Concern for power quality – three phase Diode Bridge .

UNIT-IV: CONTROLLED RECTIFIERS

9

SCR-Two transistor analogy based turn- ON – turn ON losses – thermal protection – controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor – ripple and harmonic factor -power factor mitigation, performance parameters – effect of source inductance - inverter angle limit, Applications- power regulators and motor control.

UNIT-V: AC PHASE CONTROLLERS

9

TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers, single phase and three phase cyclo converters, Applications –welding.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Analyze the operation and dynamic characteristics of power semiconductor devices, and design and simulate low-power Switch Mode Power Supplies (SMPS).
- CO2. Analyze various uncontrolled rectifier configurations and design appropriate filter circuits for specified applications.
- CO3. Evaluate the performance of n-pulse converter circuits by analyzing their operation and computing key performance parameters (THD, efficiency, ripple)
- CO4. Apply various Pulse Width Modulation (PWM) techniques to inverter circuits and analyze voltage control and harmonic elimination strategies.
- CO5. Analyze the operation of AC voltage controllers and evaluate their applications in industrial and domestic settings.

TEXT BOOKS:

- T1.Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", John Wiley and Sons, 3rd Edition (reprint), 2009
- T2.Rashid M.H., Power Electronics Circuits, Devices and Applications, Prentice Hall India, 3rd Edition, New Delhi, 2004.

REFERENCES:

- R1. Cyril. W.Lander, Power Electronics, McGraw Hill International, Third Edition, 1993.
- R2. P.S.Bimbhra, Power Electronics, Khanna Publishers, Third Edition 2003
- R3. Philip T.Krein, Elements of Power Electronics, Oxford University Press, 2013.
- R4. P.C.Sen, Power Electronics, Tata McGraw-Hill, 30th reprint, 2008.

COURSE ARTICULATION MATRIX:

EE3562	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	-	-	2	1	-	-	2	3	-	1	1	-
CO2	3	3	3	3	-	-	-	1	-	-	2	3	-	1	1	-
CO3	3	3	3	3	-	-	2	1	-	-	2	3	-	1	1	-
CO4	3	3	3	3	-	-	1	1	-	-	2	3	-	1	1	-
CO5	3	3	3	3	-	-	1	1	-	-	2	3	-	1	1	-
Average	3	3	3	3	-	-	1.5	1	-	-	2	3	-	1	1	-

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. Significance of abnormal operating conditions.
2. To provide adequate knowledge on relays and protection schemes.
3. To provide adequate knowledge on protection for devices.
4. To provide knowledge on protection schemes.
5. To provide knowledge on functioning of circuit breakers.

UNIT-I: PROTECTION SCHEMES**9**

General equation of phase and magnitude comparators, Duality of comparators, Electromagnetic relays, over current relays Directional relays, Distance relay- impedance, Reactance and Mho type, Differential relays. -Principles and need for protective schemes – nature and causes of faults – types of faults –Methods of Grounding - Zones of protection and essential qualities of protection – Protection scheme. - Protection against travelling waves.

UNIT -II: ELECTROMAGNETIC RELAYS**9**

Bus Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays. Distance protection, Pilot wire protection, Carrier current protection. -Biased differential protection, restricted earth fault protection, Field suppression, Negative sequence protection, Earth fault detection in rotor circuit.

UNIT -III: APPARATUS PROTECTION DEVICES**9**

Current transformers and Potential transformers and their applications in protection schemes -Protection of transformer, generator, motor, bus bars and transmission line, digital protection.

UNIT -IV: STATIC RELAYS AND NUMERICAL PROTECTION**9**

Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, distant protection of transmission lines.

UNIT -V: CIRCUIT BREAKERS

9

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – restriking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching -current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF₆, MCBs, MCCBs and vacuum circuit breakers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will:

- CO1. Explain the significance and application of various protection schemes used in power systems through case studies and real-world scenarios.
- CO2. Describe the working principles and characteristics of electromagnetic relays and assess their role in protection systems.
- CO3. Analyze the construction, operation, and performance of current transformers (CTs) and potential transformers (PTs) in measurement and protection.
- CO4. Evaluate the operation and performance of static and numerical relays using simulation tools or practical experiments.
- CO5. Analyze the construction, operation, and application of different types of circuit breakers based on their arc interruption techniques and system ratings.

TEXT BOOKS:

- T1. Sunil S.Rao, 'Switchgear Protection and Power Systems', Khanna Publishers, New Delhi, 14th Edition.
- T2. Badri Ram, B.H. Vishwakarma, 'Power System Protection and Switchgear', Tata McGraw Hill Education Private Limited Publishers, Second Edition 2017.

REFERENCES:

- R1. Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., Second Edition, 2018.
- R2. Arun Ingole, 'Switch Gear and Protection' Pearson Education, 2018.

R3. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2018.

Course Articulation Matrix:

EE3563	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	1	1	3	1						3	2		1
CO2	2	1	3	1	2	1	1	1	1				1	2	1	1
CO3	2	2	1	3	3	1	1			1		1	2		1	
CO4	3	3	2	1	3	1	1	1			1			1		1
CO5	3	1	1	3	2	3	1			1			1	2		
Average	2.6	2.0	1.8	1.8	2.2	1.8	1.0	1.0	1.0	1.0	1.0	1.0	1.8	1.8	1.0	1.0

OBJECTIVES:

- To introduce the basics of C programming language.
- To learn the concepts of advanced features of C.
- To understand the concepts of ADTs and linear data structures.
- To know the concepts of non-linear data structure and hashing.
- To familiarize the concepts of sorting and searching techniques.

UNIT I C PROGRAMMING FUNDAMENTALS 9

Data Types - Variables - Operations - Expressions and Statements - Conditional Statements - Functions - Recursive Functions - Arrays - Single and Multi-Dimensional Arrays.

UNIT II C PROGRAMMING – ADVANCED FEATURES 9

Structures – Union – Enumerated Data Types – Pointers: Pointers to Variables, Arrays and Functions - File Handling - Preprocessor Directives.

UNIT III LINEAR DATA STRUCTURES 9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List – Doubly-Linked Lists – Circular Linked List – Stack ADT – Implementation of Stack – Applications – Queue ADT – Priority Queues – Queue Implementation – Applications.

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees – Binary Trees – Tree Traversals – Expression Trees – Binary Search Tree – Hashing – Hash Functions – Separate Chaining – Open Addressing – Linear Probing- Quadratic Probing – Double Hashing – Rehashing.

UNIT V SORTING AND SEARCHING TECHNIQUES 9

Insertion Sort – Quick Sort – Heap Sort – Merge Sort – Linear Search – Binary Search.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 1997.
2. ReemaThareja, "Programming in C", Second Edition, Oxford University Press, 2016.

REFERENCES:

1. Brian W. Kernighan, Rob Pike, "The Practice of Programming", Pearson Education, 1999.
2. Paul J. Deitel, Harvey Deitel, "C How to Program", Seventh Edition, Pearson Education, 2013.
3. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, 1983.
4. Ellis Horowitz, SartajSahni and Susan Anderson, "Fundamentals of Data Structures", Galgotia,

2008.

OUTCOMES:

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

- Develop C programs for any real world/technical application and Apply advanced features of C in solving problems.
- Write functions to implement linear and non-linear data structure operations.
- Suggest and use appropriate linear/non-linear data structure operations for solving a given problem.
- Appropriately use sort and search algorithms for a given application.
- Apply appropriate hash functions that result in a collision free scenario for data storage and retrieval.

CO – PO – PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	2	1	1	-	1	2	1	3	-	-	-
CO2	1	2	1	2	2	-	-	-	1	1	1	2	-	-	-
CO3	2	3	1	2	3	-	-	-	1	1	1	2	-	-	-
CO4	2	1	-	1	1	-	-	-	2	1	1	2	-	-	-
CO5	1	2	1	2	2	1	1	-	1	2	1	3	-	-	-
Avg	1.6	2.2	1	1.8	2	1	1	-	1.2	1.4	1	2.4	-	-	-

OBJECTIVE:

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

UNIT- I ENVIRONMENT AND BIODIVERSITY 6

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

UNIT- II ENVIRONMENTAL POLLUTION 6

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

UNIT- III RENEWABLE SOURCES OF ENERGY 6

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

UNIT- IV SUSTAINABILITY AND MANAGEMENT 6

Definition of Sustainability, Aspects of Sustainability, Transition from Millennium Development Goals (MDGs) to Sustainable Development Goals (SDGs). The Role of UN and the Need for

SDGs and Adoption by the World, Scope and Inclusion and Agenda 2030, Our Common Future and Philosophy behind SDGs Design for sustainability, Thinking Alternatives and Innovation, Causal Mapping, Systemic Mapping and Problem Identification Identifying probable interventions for Sustainable Development, Framework and Structuring of Seventeen SDGs.

UNIT- V SUSTAINABILITY PRACTICES

6

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

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
2. To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
3. To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
4. To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
5. To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXTBOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
2. Daniel B. Botkin and Edward A. Keller "Environmental Science: Earth as a Living Planet", 8th Edition" Wiley India Publisher ,2024.
3. Deeksha Dave, S.S. Katewa, Chandana Mohanty, Sarbari Acharya, "Textbook of Environmental Studies (3rd Edition), Cengage India Publisher, 2024.
4. P.N. Palanisamy, P. Manikandan, A. Geetha, K. Manjula Rani, "Environmental Science", 4th Edition, Pearson Education Publisher,2023.
5. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 3rd edition, Pearson Education, 2023.

6. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall, 2011.
7. Bradley. A.S; Adebayo, A.O., Maria, P. Engineering Applications in Sustainable Design and Development, Cengage learning, 2015.

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. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.
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

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 protractor, Prismatic compass and its use and GPS, Setting a map, finding north and own position, Map to Ground, Ground to Map, Point to Point March

Unit IV Field Craft and Battle Craft 9
Introduction, Judging Distance, Description of ground, Recognition, description and indication of landmarks and targets, Observation, Camouflage and Concealment, Field Signals, Section Formations, Fire Control Orders, Fire and Movement, Types of knots and lashings

Unit V Seamanship and Naval Communications 9
Anchor - parts of Anchor , parts of cable Types of Anchor, Rigging- Rope, Types of ropes, Care and maintenance of rope, Bends and Hitches, Shackles and Blocks, Introduction to naval modern communication, purpose and principles, duties of various communications department, Semaphore, letters and prosigns, reading and transmission of messages, phonetic alphabets, radio telephony procedure Sonar and Radar.

TOTAL: 45 PERIODS

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

Course outcome:

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

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

Text Books

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

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To study the VI characteristics of SCR, TRIAC, MOSFET and IGBT
2. To analyze the performance of semi converter, full converter, step-up, step-down choppers by simulation and experimentation.
3. To study the behavior of voltage waveforms of PWM inverter applying various modulation techniques.
4. To design and analyze the performance of SMPS.
5. To study the performance of AC voltage controller by simulation and Experimentation.

LIST OF EXPERIMENTS:

1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT
3. AC to DC half-controlled converter
4. AC to DC fully controlled converter
5. Step down and step up MOSFET based choppers
6. IGBT based single phase PWM inverter
7. IGBT based three phase PWM inverter
8. AC Voltage controller.
9. Switched mode power converter
10. Simulation of PE circuits (1 Φ & 3 Φ semi converter, 1 Φ & 3 Φ full converter, dc-dc converters, ac voltage controllers).

Additional Experiments

11. Gate Pulse Generation using R, RC and UJT.
12. Dynamic Characteristics of SCR and MOSFET.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1. Determine the characteristics of SCR, IGBT, TRIAC, MOSFET and IGBT
- CO2. Find the transfer characteristics of full converter, semi converter, step up and step-down choppers by simulation experimentation
- CO3. Analyze the voltage waveforms for PWM inverter using various modulation techniques

- CO4. Design and experimentally verify the performance of basic DC/DC converter topologies used for SMPS.
- CO5. Analyze the performance of AC voltage controllers by simulation and experimentation.

COURSE ARTICULATION MATRIX:

EE3564	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	-	-	-	1	-	-	-	3	-	1	1	-
CO2	3	3	3	3	-	-	-	1	-	-	-	3	-	1	1	-
CO3	3	3	3	3	-	-	-	1	-	-	-	3	-	1	1	-
CO4	3	3	3	3	-	-	-	1	-	-	-	3	-	1	1	-
CO5	3	3	3	3	-	-	-	1	-	-	-	3	-	1	1	-
Average	3	3	3	3	-	-	-	1	-	-	-	3	-	1	1	-

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS		
1	Device characteristics (for SCR, MOSFET, TRIAC, GTO and IGBT kit with built-in / discrete power supply and meters)	2 each
2	Single phase SCR based half controlled converter and fully controlled converter along with built-in/separate/firing circuit/module and meter	2 each
3	MOSFET based step up and step-down choppers (Built in/Discrete).	1 each
4	IGBT based single phase PWM inverter module/Discrete Component.	2
5	IGBT based three phase PWM inverter module/Discrete component.	2
6	Switched mode power converter module/Discrete Component	1
7	SCR & TRIAC based 1 phase AC controller along with lamp or rheostat load	2
8	Cyclo converter kit with firing module	1
9	Dual regulated DC power supply with common ground	2
10	Cathode ray Oscilloscope	10
11	Isolation Transformer	5
12	Single phase Auto transformer	3
13	Components (Inductance, Capacitance)	3
14	Multimeter	5
15	LCR meter	3

16	Rheostats of various ranges	2 sets of 10 value
17	Work table	10
18	DC and AC meters of required ranges	20
19	Component data sheets to be provided	

COURSE OBJECTIVES:

1. To train the students in testing the characteristics of Boolean functions.
2. To provide adequate inputs on a variety of circuit behavior with code converters.
3. To design various synchronous and asynchronous circuits.
4. To train the students in Application of Op-Amp.
5. To provide adequate knowledge of Voltage to frequency characteristics of NE/ SE 566 IC

LIST OF EXPERIMENTS:

1. Implementation of Boolean Functions, Adder/ Subtractor circuits.
2. Code converters: Excess-3 to BCD and Binary to Gray code converter and vice-versa
3. Parity generator and parity checking
4. Encoders and Decoders
5. Counters: Design and implementation of 4-bit modulo counters as synchronous and Asynchronous types using FF IC's and specific counter IC.
6. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.
7. Study of multiplexer and demultiplexer
8. Timer IC application: Study of NE/SE 555 timer in Astable, Monostable operation.
9. Application of Op-Amp: inverting and non-inverting amplifier, Adder, comparator, Integrator and Differentiator.
10. Study of VCO and PLL ICs:
11. Voltage to frequency characteristics of NE/ SE 566 IC.
12. Frequency multiplication using NE/SE 565 PLL IC.

TOTAL: 45 PERIODS**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:**

S.No	Name of the equipment / Components	Quantity Required
1.	Dual ,(0-30V) variable Power Supply	15
2.	CRO - 30MHz	9
3.	Digital Multimeter	10
4.	Function Generator- 1 MHz	8
5.	IC Tester (Analog)	2
6.	Bread board	10

7. Computer (PSPICE installed) 1

Consumable

8.	IC 741/ IC NE555/566/565	25
9.	Digital IC types	25
10.	LED	25
11.	LM317	25
12.	LM723	25
13.	ICSG3524 / SG3525	25
14.	Transistor – 2N3391	25
15.	Diodes, IN4001, BY126	25
16.	Zener diodes	25
17.	Step-down transformer, 230V/12-0-12V	1
18.	Resistors 1/4 Watt Assorted	25
19.	Single Strand Wire	

COURSE OUTCOMES:

- CO1. Ability to understand and analyze the characteristics of Boolean functions.
- CO2. Ability to provide adequate inputs on a variety of circuit behavior with code converters.
- CO3. Ability to design various synchronous and asynchronous circuits.
- CO4. Ability to train the students in Application of Op-Amp.
- CO5. Ability to provide adequate knowledge of Voltage to frequency characteristics of NE/ SE 566 IC

REFERENCES:

- R1. Laboratory Manual prepared by Course Coordinator

COURSE ARTICULATION MATRIX:

EE3565	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3				1				3		1	1	
CO2	3	3	3	3				1				3		1	1	
CO3	3	3	3	3				1				3		1	1	
CO4	3	3	3	3				1				3		1	1	
CO5	3	3	3	3				1				3		1	1	
Average	3	3	3	3				1				3		1	1	

IT3564 C PROGRAMMING AND DATA STRUCTURES LABORATORY

L	T	P	C
0	0	3	1.5

OBJECTIVES:

- To develop applications in C.
- To implement linear and non-linear data structures
- To understand the different operations of search trees.
- To get familiarized to sorting and searching algorithms.
- To understand the different hashing techniques.

LIST OF EXPERIMENTS:

1. Practice of C programming using statements, expressions, decision making and iterative Statements.
2. Practice of C programming using Functions and Arrays
3. Implement C programs using Pointers and Structures
4. Implement C programs using Files
5. Development of real time C applications
6. Array implementation of List ADT
7. Array implementation of Stack and Queue ADTs
8. Linked list implementation of List, Stack and Queue ADTs
9. Applications of List, Stack and Queue ADTs
10. Implementation of Binary Trees and operations of Binary Trees
11. Implementation of Binary Search Trees
12. Implementation of searching techniques
13. Implementation of Sorting algorithms: Insertion Sort, Quick Sort, Merge Sort
14. Implementation of Hashing - any two collision techniques

Requirements for a batch of 30 students

Software

- Compiler: A compiler like Dev C++ or GCC
- Operating system: A Windows or UNIX operating system, or Linux with gcc/g++
- Text editor: A text editor like gedit

Hardware

- A computer that can run C/C++ programs

OUTCOMES:

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

- Use different constructs of C and develop applications
- Write functions to implement linear and non-linear data structure operations
- Suggest and use the appropriate linear / non-linear data structure operations for a given problem
- Apply appropriate hash functions that result in a collision free scenario for data storage and Retrieval
- Implement Sorting and searching algorithms for a given application

CO – PO – PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1	2	2	1	1	-	1	2	1	3	-	-	-
CO2	1	2	1	2	2	-	-	-	1	1	1	2	-	-	-
CO3	2	3	1	2	3	-	-	-	1	1	1	2	-	-	-
CO4	2	1	-	1	1	-	-	-	2	1	1	2	-	-	-
CO5	1	2	1	2	2	1	1	-	1	2	1	3	-	-	-
Avg	1.6	2.2	1	1.8	2	1	1	-	1.2	1.4	1	2.4	-	-	-

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. Significance of power system operation and control.
2. To provide adequate knowledge on real power-frequency interaction and design of power-frequency controller.
3. To study expose the different techniques of measuring High voltages and high currents. Reactive power-voltage interaction and the control actions to be implemented for maintaining the voltage profile against varying system load.
4. To provide economic operation of power system.
5. SCADA and its application for real time operation and control of power systems

UNIT-I: BASICS OF POWER SYSTEM OPERATION AND CONTROL**9**

Power scenario in Indian grid – National and Regional load dispatching centers requirements of good power system - necessity of voltage and frequency regulation - real power vs frequency and reactive power vs voltage control loops -system load variation, load curves and basic concepts of load dispatching – load forecasting - Basics of speed governing mechanisms and modeling - speed load characteristics - regulation of two generators in parallel. Introduction of Restructured power system.

UNIT -II: REAL POWER - FREQUENCY CONTROL**9**

Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases - LFC of two area system - tie line modeling - block diagram representation of two area system - static and dynamic analysis - tie line with frequency bias control – state variability model integration of economic dispatch control with LFC.

UNIT -III: REACTIVE POWER – VOLTAGE CONTROL**9**

Generation and absorption of reactive power - basics of reactive power control automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis – stability compensation – voltage drop in transmission line - methods of reactive power injection - tap changing transformer, SVC (TCR + TSC) and STATCOM for voltage control.

UNIT -IV: ECONOMIC OPERATION OF POWER SYSTEM

9

Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - base point and participation factors method - statement of unit commitment (UC) problem - constraints on UC problem - solution of UC problem using priority list

UNIT -V: COMPUTER CONTROL OF POWER SYSTEMS

9

Need of computer control of power systems-concept of energy control centers and functions – PMU - system monitoring, data acquisition and controls – System hardware configurations. SCADA and EMS functions - state estimation problem –measurements and errors - weighted least square estimation - various operating states - state transition diagram.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Explain the significance of power system operation and control in maintaining system reliability, security, and efficiency.
- CO2. Analyze the interaction between real power and system frequency and evaluate control mechanisms for frequency regulation.
- CO3. Interpret the relationship between reactive power and voltage magnitude and assess voltage control strategies in power systems.
- CO4. Analyze and recommend appropriate control actions (like load frequency control and economic load dispatch) to handle real-time variations in system demand.
- CO5. Design basic SCADA systems and explain their role in real-time monitoring and control of power system operations.

TEXT BOOKS:

- T1. Olle. I. Elgerd, 'Electric Energy Systems theory – An introduction', McGraw Hill Education Pvt. Ltd., New Delhi, 2nd edition, 2017.
- T2. Allen. J. Wood and Bruce F. Wollen berg, 'Power Generation, Operation and Control', John Wiley & Sons, Inc., 3rd edition, 2013.

REFERENCES:

- R1. Kundur P., Power System Stability and Control, McGraw Hill Education Pvt. Ltd., New Delhi, 10th reprint, 2010.

- R2. Abhijit Chakrabarti and Sunita Halder, 'Power System Analysis Operation and Control', PHI learning Pvt. Ltd., New Delhi, Fourth Edition, 2018.

Course Articulation Matrix:

EE3661	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	3	2	1		3	1						1	2		
CO2	2	1	3	1	2								1	2	1	
CO3	1	2	1	3	3								2		1	
CO4	1	3	2	1	3		1				1			1		1
CO5	3	1	1	3	2	3							1	2		
Average	1.6	2	1.8	1.8	2.5	3	1				1		1.3	1.8	1	1

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To analyze steady state operation and transient dynamics of a motor load system.
2. To study and analyze the operation of the converter/chopper fed DC drive, both qualitatively and quantitatively.
3. To study and analyze the operation and performance of AC motor drives.
4. To analyze and design the current and speed controllers for a closed loop solid state DC motor drive.
5. To study and analyze the operation and performance of synchronous motor drives.

UNIT-I: DRIVE CHARACTERISTICS**9**

Electric drive – AC and DC Drives - Equations governing motor load dynamics – steady state stability– multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor, modes of operation.

UNIT -II: CONVERTER / CHOPPER FED DC MOTOR DRIVE**9**

Steady state analysis of the single and three phase converter fed separately excited DC motor drive – Converter fed DC Self-Excited motor drive - continuous and discontinuous conduction– Time ratio and current limit control – 4 quadrant operations of converter / chopper fed drive- Effect of ripples on the DC motor performance – Applications of DC Drives.

UNIT -III: INDUCTION MOTOR DRIVES**9**

Stator voltage control–energy efficient drive–v/f control–constant air gap flux–field weakening mode– Voltage / current fed inverter – closed loop control-slip power recovery scheme- vector control - Applications of Induction motor Drives.

UNIT -IV: SYNCHRONOUS MOTOR DRIVES**9**

V/f control and self-control of synchronous motor: Margin angle control and power factor control- Three phase voltage/current source fed synchronous motor- Applications. Effects of Harmonics – Application of Synchronous motor Drives.

Transfer function for DC motor / load and converter – closed loop control with Current and speed feedback–armature voltage control and field weakening mode –Design of Controllers; current controller and speed controller- converter selection and characteristics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: To Analyze drive characteristics.

CO2: To Analyze chopper fed drive.

CO3: To Analyze induction motor drives.

CO4: To Analyze synchronous motor drives.

CO5: To Analyze design of controllers for drives.

TEXT BOOKS:

T1.Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2002.

T2.Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.

REFERENCES:

R1. R.Krishnan, Electric Motor & Drives: Modeling, Analysis and Control Prentice Hall of India, 2001.

R2.John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier 2012.

R3.Shaahin Felizadeh, "Electric Machines and Drives", CRC Press(Taylor and Francis Group),2013.

R4.S.Sivanagaraju, M. Balasubba Reddy, A. Mallikarjuna Prasad "Power semiconductor drives" PHI, 5th printing, 2013.

R5.N.K.De., P.K.Sen "Electric drives" PHI, 2012.

COURSE ARTICULATION MATRIX:

EE3662	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	1					1				1	1			
CO2	2	3	2		2								2	3	2	1
CO3	2	2	2			1			3				3			1
CO4	2	3	3	1						2			3		2	1
CO5	3	2	2	2								1	3	2		1
Average	2.4	2.4	2	1.5	2	1		1	3	2		1	2.4	2.5	2	1

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. Architecture of μ P8085 & μ C 8051
2. Architecture of μ P8086
3. Addressing modes & instruction set of 8085 & 8051.
4. Need & use of Interrupt structure 8085 & 8051.
5. Simple applications development with programming 8085 & 8051.

UNIT-I: 8085 PROCESSOR**9**

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts – Memory Interfacing

UNIT-II: PROGRAMMING OF 8085 PROCESSOR**9**

Instruction -format and addressing modes – Assembly language format – Data transfer, data manipulation & control instructions – Programming: Loop structure with counting & Indexing – Look up table - Subroutine instructions - stack.

UNIT-III: 8051 MICRO CONTROLLER**9**

Hardware Architecture, pinouts – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts-Data Transfer, Manipulation, Control Algorithms& I/O instructions, Comparison to Programming concepts with 8085.

UNIT-IV: PERIPHERAL INTERFACING**9**

Study on need, Architecture, configuration and interfacing, with ICs: 8255, 8259, 8254, 8279, - A/D and D/A converters & Interfacing with 8085 & 8051.

Simple programming exercises- key board and display interface –Control of servomotor- Temperature control system –stepper motor control- Application to automation systems. Arduino UNO Board-Architecture-Arduino IoT - Communications -Sensing-Displays. Raspberry Pi Development Board- Architecture - Raspberry Pi IoT –Usage of IDE for assembly language programming.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- CO1. Ability to acquire knowledge in Addressing modes & instruction set of 8085 & 8051.
- CO2. Ability to need & use of Interrupt structure 8085 & 8051.
- CO3. Ability to understand the importance of Interfacing.
- CO4. Ability to explain the architecture of Microprocessor and Microcontroller and its applications.
- CO5. Ability to write the assembly language programme.

TEXT BOOKS:

- T1. Sunil Mathur & Jeebananda Panda, “Microprocessor and Microcontrollers”, PHI Learning Pvt. Ltd, 2016.
- T2. R.S. Gaonkar, ‘Microprocessor Architecture Programming and Application’, with 8085, Wiley Eastern Ltd., New Delhi, 2013.
- T3. Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D. Kinely ‘The 8051 Micro Controller and Embedded Systems’, PHI Pearson Education, 5th Indian reprint, 2007.

REFERENCES BOOKS:

- R2. Krishna Kant, “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice Hall of India, New Delhi, 2013.
- R3. B.RAM,” Computer Fundamentals Architecture and Organization” New Age International Private Limited, Fifth edition, 2018.
- R3. Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051, McGraw Hill Edu,2017.
- R4. Ajay V.Deshmukh, ‘Microcontroller Theory & Applications’, McGraw Hill Edu, 2016
- R5. Douglas V.Hall, ‘Microprocessor and Interfacing’, McGraw Hill Edu,2016.
- R6. Arduino for Beginners: Essential Skills Every Maker Needs, John Baichtal, Pearson Education, Inc.,1st edition

R7. Raspberry Pi User Guide, Eben Upton and Gareth Halfacree, John Wiley & sons, 2016

COURSE ARTICULATION MATRIX:

EE3663	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	2	2				2							
CO2	3	2	2	1	1		2		1		2					
CO3	3	2	1	1	3				3		2					
CO4	1	2	2	3	3						3	2				
CO5	1	2	1	2	3						1	1				
Average	2.2	2.2	1.8	1.8	2.4		2		2		2	1.5				

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To perform simple arithmetic operations using assembly language program and study the addressing modes & instruction set of 8085 & 8051
2. To develop skills in simple program writing in assembly languages.
3. To write an assembly language program to convert Analog input to Digital output and Digital input to Analog output.
4. To perform interfacing experiments with μ P8085 and μ C8051
5. To Program Arduino and Raspberry pi with software tools.

LIST OF EXPERIMENTS:**PROGRAMMING EXERCISES / EXPERIMENTS WITH μ P8085:**

1. Simple arithmetic operations: Multi precision addition / subtraction /multiplication / division.
2. Programming with control instructions: Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions.
3. Interface Experiments: A/D Interfacing. D/A Interfacing. Traffic light controller
4. Stepper motor controller interface.
5. Displaying a moving/ rolling message in the student trainer kit's output device.

PROGRAMMING EXERCISES / EXPERIMENTS WITH μ C8051:

6. Simple arithmetic operations with 8051: Multi precision addition / subtraction / multiplication/ division.
7. Programming with control instructions: Increment / Decrement, Ascending / Descending. order, Maximum / Minimum of numbers, Rotate instructions, Hex / ASCII / BCD code conversions.
8. Interface Experiments: A/D Interfacing. D/A Interfacing. Traffic light controller
9. Stepper motor controller interface.
- 10.Programming Arduino with software tools.
- 11.Programming Raspberry pi with software tools.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1. 8085 Microprocessor Trainer with Power Supply	15
2. 8051 Micro Controller Trainer Kit with power supply	15
3. 8255 Interface boards	05
4. 8251 Interface boards	05
5. 8259 Interface boards	05
6. 8279 Keyboard / Display Interface boards	05
7. 8254 timer/ counters	05
8. ADC and DAC cards	05
9. AC & DC motor with Controllers	05
10. Traffic Light Control Systems	05
11. Arduino (UNO and NANO)	05
12. Raspberry pi	05

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

- CO1. Ability to write assembly language program for microprocessor
- CO2. Ability to write assembly language program for microcontroller
- CO3. Ability to design and implement interfacing of peripheral with microprocessor and microcontroller
- CO4. Ability to analyse, comprehend, design and simulate microprocessor-based systems used for control and monitoring.
- CO5. Ability to analyse, comprehend, design and simulate microcontroller-based systems (8051, Arduino and Raspberry pi) used for control and monitoring.

REFERENCES:

R1. Laboratory Manual prepared by Course Coordinator

COURSE ARTICULATION MATRIX:

EE3664	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	2	3				1.5				3				
CO2	2	1	2	3				1.5				3				
CO3	2	1	2	3				1.5				3				
CO4	2	1	2	3				1.5				3				
CO5	2	1	2	3				1.5				3				
Average	2	1	2	3				1.5				3				

COURSE OBJECTIVES:

To impart knowledge on the following topics

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

COURSE DESCRIPTION:

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

- CO1. Frame the problem solution
- CO2. Explore the knowledge in the corresponding field of project.
- CO3. Compare the model with the existing system.
- CO4. Demonstrate the model designed for the solution.
- CO5. Publish the results obtained from the model.

COURSE ARTICULATION MATRIX:

EE3641	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	3	2	0	1	2	2	3	3	3	3	2	1	2
CO2	3	2	3	3	2	0	1	2	2	3	3	3	3	3	1	2
CO3	3	1	3	3	2	0	1	2	2	3	3	3	3	3	3	1
CO4	3	2	3	3	2	0	1	2	2	3	3	3	3	2	2	1
CO5	3	1	3	3	2	0	1	2	2	3	3	3	1	2	3	1
Average	3	1.6	3	3	2	0	1	2	2	3	3	3	2.6	2.4	2	1.4

OBJECTIVES

The course aims to

- enhance the Employability and Career Skills of students.
- orient the students towards grooming as a professional.
- to learn how to speak in Group Discussions
- make them employable Graduates and help them attend interviews successfully.
- develop their confidence and help them express views clearly

UNIT- I**6**

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

UNIT- II**6**

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

UNIT- III**6**

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

UNIT- IV**6**

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

UNIT- V**6**

Recognizing differences between groups and teams - networking professionally- respecting

social protocols- understanding career management- developing a long- term career plan- making career changes. – organizing a larger unit of discourse – expressing and justifying opinions – negotiating – collaborating – disagreeing – speculating – decision taking.

Total Periods: 30

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

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

OUTCOMES:

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

- 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.

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

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

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. Various types of over voltages in power system and protection methods.
2. Generation of over voltages in laboratories
3. Measurement of over voltages.
4. Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics
5. Testing of power apparatus and insulation coordination.

UNIT-I: OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS**9**

Causes of over voltages and its effects on power system – Lightning, switching surges and temporary over voltages – Reflection and Refraction of Travelling waves- protection against over voltages-Insulation Coordination

UNIT -II: DIELECTRIC BREAKDOWN**9**

Properties of Dielectric materials - Gaseous breakdown in uniform and non-uniform fields –Corona discharges – Vacuum breakdown – Conduction and breakdown in pure and commercial liquids, Maintenance of oil Quality – Breakdown mechanisms in solid and composite dielectrics- Applications of insulating materials in electrical equipment.

UNIT-III: GENERATION AND MEASUREMENTS OF HIGH VOLTAGES AND HIGH CURRENTS**9**

Generation of High DC, AC, impulse voltages and currents - Analysis of DC/AC and Impulse generator circuits - Tripping and control of impulse generators, Measurement of High voltages, and High currents – High Resistance with series ammeter – Dividers - Resistance, Capacitance and Mixed dividers - Peak Voltmeter, Generating Voltmeters, Electrostatic Voltmeters – Sphere Gaps, High current shunts, Digital techniques in high voltage measurement.

UNIT -IV: HIGH VOLTAGE TESTING & INSULATION COORDINATION

9

High voltage testing of electrical power apparatus- International and Indian standards – Power frequency, impulse voltage and DC testing of Insulators, circuit breakers, bushing, isolators, and transformers - Insulation Coordination.

UNIT -V: APPLICATION IN INDUSTRY

9

Introduction – electrostatic applications- electrostatic precipitation, separation, painting / coating, spraying, imaging, printing, Transport of materials – manufacturing of sand paper – Smoke particle detector – Electrostatic spinning, pumping, propulsion – Ozone generation – Biomedical applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Explain various overvoltage's and its effects on power systems.
- CO2. Understand the breakdown phenomena in different medium under uniform and non- uniform fields.
- CO3. Explain the methods of generating and measuring High DC, AC, Impulse voltage, and currents.
- CO4. Suggest and Conduct suitable HV testing of Electrical power apparatus as per Standards.
- CO5. Explain the Industrial Applications of Electrostatic Fields.

TEXT BOOKS:

- T1. M.S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2017.
- T2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second Edition, Elsevier , New Delhi, 2008.

REFERENCES:

- R1. L.L.Alston, High Voltage Technology, Oxford University Press, First Indian Edition 2008.

R2. C.L.Wadhwa, High voltage Engineering, New Age International Publishers, Fourth Edition, 2020

R3. Mazen Abdel – Salam, Hussein Anis, Ahdab A-Morshedy, RoshdayRadwan, High Voltage Engineering – Theory &Practice, Second Edition, Taylor & Francis Group, 2019

COURSE ARTICULATION MATRIX:

EE3761	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	3	2	3								3		1	
CO2	1	1	3	1	2	1			1		1			2		
CO3	3	1	1	1	3			3		1				1		2
CO4	3	2	1	3	1		1							2		2
CO5	2	1	2	2	3	1						1	2			
Average	2.4	1.4	2.0	1.8	2.4	1	1	3	1	1	1	1	2.5	1.7	1	2

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. Awareness about renewable Energy Sources and technologies.
2. Knowledge in wind energy power generation.
3. Understand the fundamental theory governing solar thermal and photovoltaic devices.
4. Understand the biomass energy system.
5. Knowledge in other forms of energy sources like geothermal energy, Ocean energy, hydro power, fuel cell.

UNIT-I: RENEWABLE ENERGY (RE) SOURCES**9**

Environmental consequences of fossil fuel use, need for renewable energy sources, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources

UNIT -II: WIND ENERGY**9**

Wind energy, classification of wind turbines, extraction of wind turbine power, Types of Wind Power Plants (WPPs)–Components of WPPs, Working of WPPs- Siting of WPPs, modes of wind power generation – stand-alone and grid connected system.

UNIT -III: SOLAR THERMAL COLLECTORS AND PV**9**

Solar Radiation and its measurement, Solar collectors, Solar photovoltaic technology – introduction – solar cell basics – Types of solar cells and modules, PV Module I-V Characteristics, Efficiency & Quality of the Cell, Design of solar PV system, series and parallel connections, maximum power point tracking, Applications.

UNIT -IV: BIOMASS ENERGY**9**

Bio-Mass: Energy from biomass, Sources from biomass, Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C. Engine operation and economic aspects.

UNIT -V: OTHER ENERGY SOURCES**9**

Geothermal Energy: Resources, types of wells, methods of harnessing the energy, Mini/micro

hydro power: Classification of hydropower schemes, Classification of water turbine, Ocean Energy: Introduction, Principle of ocean thermal energy conversion (OTEC), Tidal power generation: Tidal energy technologies, Energy from waves, Wave energy conversion, Wave energy technologies, advantages and disadvantages. Fuel cell: Principle of working- various types - construction and applications. Energy Storage System- Hybrid Energy Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1: Gain awareness about renewable Energy Sources and technologies.
- CO2: Explain and analyze the working principles and components involved in wind energy power generation.
- CO3: Apply and interpret the fundamental theory governing solar thermal and photovoltaic devices.
- CO4: Explain and evaluate the functioning and components of biomass energy systems.
- CO5: Compare and assess different forms of alternative energy sources including geothermal, ocean energy, hydropower, and fuel cells

TEXT BOOKS:

- T1.D.P. Kothari, K.C. Singal, Rakesh Ranjan, “Renewable Energy Sources and Emerging Technologies”, Third Edition, PHI Learning, 2022.
- T2.Mehmet Kanoğlu, Yunus A. Çengel, and John M. Cimbala, “Fundamentals and Applications of Renewable Energy”, McGraw-Hill Education,2020.
- T3.S.C. Bhatia, R. K. Gupta, “Textbook of Renewable Energy”, WPI Publishing, 2019.

REFERENCES:

- R1. Richard A. Dunlap,” Sustainable Energy” Cengage Learning India Private Limited, Delhi, 2015.
- R2. John Twidell and Tony Wier, “Renewable Energy Resources”, Third Edition, Routledge, Taylor & Francis Group2015.
- R3. G D Rai, ‘Non-conventional Energy sources’, Khanna Publishers, 5th Edition, 2014.
- R4. A.K.Mukerjee and Nivedita Thakur,” Photovoltaic Systems: Analysis and Design”, PHI Learning Private Limited, New Delhi, 2011.

COURSE ARTICULATION MATRIX:

EE3762	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1		3	1			2			1			3			
CO2	2				2			3				2		3	1	
CO3	1	2		3		3			3					2		
CO4				2				2			2				1	
CO5	3	1			1			2				1				
Average	1.8	1.5	3	2	1.5	3	2	2.3	3	1	2	1.5	3	2.5	1	

OBJECTIVES:

1. To introduce and educate the students on the concept of Human Values.
2. To support students to understand the need, basic guidelines, content and process of value education.
3. To facilitate the students to understand harmony at all the levels of human living.
4. To help the students to understand social ethics and live accordingly.
5. 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.

TOTALHOURS: 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. Nagarajan, 'A Textbook on Professional Ethics and Human Values' New Age International Publishers, 2015.
8. World Community Service Centre, "Value Education", Vethathiri publications, Erode, 2011.
9. Langford, Duncan (EDT): Internet Ethics, London, Macmillan Press Ltd., 2000.
10. Erwann, M. David, Michele S. Shauf, Computers, Ethics and Society, Oxford University Press, 2003.

11. Suresh Jayshree, 2003, Human Values and Professional Ethics, ,S. Chand Publishing, Third Revised Edition.

E-BOOK :

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

CO-PO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1							1	
CO2			1					
CO3							1	
CO4				1				
CO5				2				
Average			1	1.5			1	

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To provide better understanding of power system analysis through digital Simulation.
2. To present a problem-oriented knowledge of power system analysis methods.
3. To address the underlying concepts & approaches behind analysis of power system network using software tools.
4. To identify & formulate solutions to problems relevant to power system using software tools.
5. To solve power flow problem for simple power systems.

LIST OF EXPERIMENTS:

- 1 Computation of Transmission Line Parameters.
- 2 Formation of Bus Admittance and Impedance Matrices and Solution of Networks
- 3 Power Flow Analysis using Gauss-Seidel Method.
- 4 Power Flow Analysis using Newton Raphson Method
- 5 Symmetric and unsymmetrical fault analysis
- 6 Transient stability analysis of SMIB System
- 7 Economic Dispatch in Power Systems
- 8 Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
- 9 State estimation: Weighted least square estimation
- 10 Electromagnetic Transients in Power Systems: Transmission Line Energization
- 11 Power flow analysis using Fast decoupled method.
- 12 Study of protective relaying schemes of Power Apparatus

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

1. Personal computers (Intel i3, 80GB, 2GBRAM)	30
2. Printer-(Laser or Dot Matrix)	1
3. Server (Intel i5, 80GB, 2GBRAM) (High Speed Processor)	1
	4 User
4. Software: any power system simulation software (Licensed Version)	30 User
5. Compilers: C, C++, VB.VC++	30 User

TOTAL: 45 Periods

COURSE OUTCOMES:

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

- CO1. Explain the objectives and methodologies of power system planning and operational studies with reference to system reliability and efficiency.
- CO2. Formulate and compute Bus Admittance (Y-bus) and Impedance (Z-bus) matrices for power networks and solve network equations using matrix methods.
- CO3. Perform power flow analysis using Gauss-Seidel (GS) and Newton-Raphson (NR) methods and interpret the results for system performance evaluation.
- CO4. Analyze the system behavior under symmetrical and unsymmetrical fault conditions using sequence networks and fault calculation techniques.
- CO5. Evaluate economic dispatch of generating units considering operational constraints and analyze electromagnetic transients in power systems using standard methods.

REFERENCES:

- R1. Laboratory Manual prepared by Course Coordinator

COURSE ARTICULATION MATRIX:

EE3763	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	2			1					1						1
CO2			1	2		2						1	3			
CO3		1					1			2				1		
CO4	1		2			3		1			1		2		3	1
CO5		2		1	2						2			1		
Average	1	1.7	1.5	1.5	1.5	2.5	1	1		1.5	1.5	1	2.5	1	3	1

COURSE OBJECTIVES:

1. To train the students in Renewable Energy Sources and technologies.
2. To provide adequate inputs on a variety of issues in harnessing Renewable Energy.
3. To recognize current and possible future role of Renewable energy sources.
4. To train the students in intelligent controllers for hybrid systems.
5. To provide adequate knowledge of simulation study on Renewable Energy Sources.

LIST OF EXPERIMENTS:

1. Simulation study on Solar PV Energy System.
2. Experiment on VI-Characteristics and Efficiency of 1kWp Solar PV System.
3. Experiment on Partial shading effect in 1kWp Solar PV system.
4. Experiment on Performance assessment of Grid connected and Standalone 1kWp Solar Power System.
5. Simulation study on Wind Energy Generator.
6. Experimental study on thermal performance of solar water heater
7. Simulation study on Hybrid (Solar-Wind) Power System.
8. Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.
9. Simulation study on Hydel Power.
10. Simulation study on Intelligent Controllers for Hybrid Systems.
11. Simulation study of converter using solar PV systems.

TOTAL: 45 PERIODS**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:**

S.No	Name of the equipment / Components	Quantity Required
1.	Personal computers (Intel i3, 80GB, 2GB RAM)	15
2.	CRO - 30MHz	9
3.	Digital Multimeter	10
4.	PV panels - 100W, 24V	1
5.	Battery storage system with charge and discharge control 40Ah	1
6.	PV Emulator	1
Consumable		
7.	Potentiometer	5
8.	Step-down transformer - 230V/12-0-12V	5

9. Component data sheets to be provided

COURSE OUTCOMES:

- CO1. Ability to understand and analyze Renewable energy systems.
- CO2. Ability to train the students in Renewable Energy Sources and technologies.
- CO3. Ability to provide adequate inputs on a variety of issues in harnessing Renewable Energy.
- CO4. Ability to recognize current and possible future role of Renewable energy sources.
- CO5. Ability to simulate the various Renewable energy sources and to understand basics.

REFERENCES:

- R1. Laboratory Manual prepared by Course Coordinator

COURSE ARTICULATION MATRIX:

EE3764	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	3					3			1			1			
CO2		3	2		1							2		2	3	
CO3	1	2		2		3								2		
CO4		2						2			3				2	
CO5			1		3			1	1					3		3
Average	1.5	2.5	1.5	2	2	3	3	1.5	1	1	3	2	1	1.4	2.5	3

COURSE OBJECTIVES:

The student should be made to:

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

COURSE DESCRIPTION:

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

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

Students will maintain the record of the work done in the industry and submit a report in the institute within one week of the start of the next semester. The certificate and the report must be submitted. the company.

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

TOTAL: 15 DAYS

COURSE OUTCOMES:

The student should be able to:

- CO1. Apply the knowledge, skills, and experience to a work environment.
- CO2. Acquire new learning through challenging and meaningful activities.

- CO3. Build and maintain strong networking/mentoring relationships.
- CO4. Identify, clarify and/or confirm professional direction as it relates to the academic studies and future career path.
- CO5. Develop self-understanding, self-discipline, maturity and confidence.

COURSE ARTICULATION MATRIX:

EE3741	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	2	3	3			2	3	3	3	3		3
CO2	3		3	3	3	3	3	2	3	2	3	3	3	3	3	3
CO3		3	3		2				2	3	3	3	3	3		2
CO4	3	3	3	3	3		2	2	3	2		3	3		3	
CO5	2			3	3	2			2	3	2	1	2			2
Average	2.8	3	3	3	2.6	2.7	2.7	2	2.5	2.4	2.8	2.6	2.8	3	3	2.5

COURSE OBJECTIVES:

The student should be made to:

1. Consolidate the literature search and formulate the problem for the project work.
2. Develop their own innovative prototype of ideas.
3. Design the project to meet specification using the modern tools.
4. Improve the team building, communication and management skills of the students.
5. Train the students in preparing project reports and to face reviews and viva voce examination.

COURSE DESCRIPTION:

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

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

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

TOTAL: 300 PERIODS

COURSE OUTCOMES:

- CO1. Apply the fundamental knowledge and skills in engineering and effectively formulate a project.
- CO2. Analyze and categorize executable project modules after considering risks.
- CO3. Choose efficient tools for designing project modules.
- CO4. Combine all the modules through effective team work after efficient testing and compile the project report.
- CO5. Explore the knowledge of real-world situations that a professional engineer can encounter.

COURSE ARTICULATION MATRIX:

EE3841	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	2	3	3		3	2	3	3	3	3		3
CO2	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3	3
CO3	3	3	3	3	2				2	3	3	3	3	3	3	2
CO4	3	3	3	3	3		2	2	3	2	3	3	3	3	3	3
CO5	2	1		3	3				2	3	2	1	2			2
Average	2.8	2.6	3	3	2.6	3	2.7	2	2.6	2.4	2.8	2.6	2.8	3	3	2.6

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To know various electric drives and traction motors with applications
2. To introduce the energy saving concept by different ways of illumination.
3. To understand the different methods of electric heating and electric welding.
4. To know the conversion of solar and wind energies into electrical energy for different applications.
5. To study the domestic utilization of electrical energy.

UNIT-I: ELECTRIC DRIVES AND TRACTION**9**

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption traction motor control - track equipment and collection gear-**Review of existing electric traction systems in India.**

UNIT -II: ILLUMINATION**9**

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED.

UNIT -III: HEATING AND WELDING**9**

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types resistance welding - arc welding - power supply for arc welding - radiation welding-Comparison between A.C.-and D.C. Welding.

UNIT -IV: ENERGY CONSERVATION AND ITS IMPORTANCE**9**

Energy conservation act 2001 and its Features-Review of Industrial Energy Conservation-Energy conservation in electrical Industries-Simulation study of energy conservation using power factor controller. (Three phase circuit simulation with and without capacitor).

UNIT -V: DOMESTIC UTILIZATION OF ELECTRICAL ENERGY

9

House wiring - working principle of air conditioning system, Induction based appliances, Online and OFF-line UPS, Batteries - Power quality aspects – nonlinear and domestic loads – Earthing system for Domestic, Industrial and Substation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Ability to choose suitable electric drives for different applications.
- CO2. Ability to design the illumination systems for energy saving.
- CO3. Ability to demonstrate the utilization of electrical energy for heating and welding purposes
- CO4. Ability to know the effective usage of solar and wind energies for electrical applications
- CO5. Ability to do electric connection for any domestic appliance like refrigerator, battery charging circuit for a specific household application.

TEXT BOOKS:

- T1.N.V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Limited, New Age International Limited, 1994 & Second Edition 2017 Feb.
- T2.J.B.Gupta, “Utilisation Electric power and Electric Traction”, S.K. Kataria & Sons; 2012th edition (1 January 2013); S.K. Kataria & Sons.
- T3.G.D.Rai, “Non-Conventional Energy sources”, Khanna publications Ltd., New Delhi 1998

REFERENCES:

- R1 R.K.Rajput, Utilisation of Electric Power, Laxmi publications 2nd Edition 2016.
- R2 H.Partab, Art and Science of Utilisation of Electrical Energy”, Edition, Dhanpat Rai and Co., New Delhi-2004.
- R3 C.L.Wadhwa, “Generation, Distribution and Utilisation of Electrical Energy”, New Age international Pvt.Ltd., 3rd Edition, 2015 January.
- R4 D.P.Kothari, K.C.Singal, Rakesh Ranjan, “Renewable Energy Sources and Emerging Technologies”, PHI Learning Private Limited, 3rd Edition 2021.
- R5 Industrial Energy Conservation, Volume I-II, S C Bhatia, Sarvesh Devraj, Woodhead Pub India; First Edition (30 June 2018).

COURSE ARTICULATION MATRIX:

PEE101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2	1		1		2					3			
CO2	2	1	3					2					3			
CO3	3	2	2			1		2					3			
CO4	1	2	3					2					3	3	2	
CO5	1	1	3			1		2					3	3	3	
Average	2	1.8	2.6	1		1		2					3	3	2.5	

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. Ability to understanding Power Cable Characteristics and Applications.
2. Ability to analyze of the Cable Manufacturing.
3. Understand the concept of Installation of underground power cables
4. Understand the concept of Underground cable System Fault Locating.
5. Ability to analyze Testing and maintenance of Underground cable system.

UNIT-I: SUBSTATION DESIGN DEVELOPMENT**9**

Development of Underground Cables - Electric Lighting- Distribution of Energy for Lighting- Paper Insulated Cables – Under Ground and Over Head Systems- Underground Residential Distribution Systems- Underground Residential Distribution Systems- Medium Voltage Cable Development.

UNIT -II: CABLE ARCHITECHTURE, DIELECTRIC THEORY AND CABLE CHARACTERISTICS**9**

Architecture of Underground Cabling System - Basic Dielectric Theory of Cable – Conductors - Armour and Protective Finishes - Cable Characteristics: Electrical- Fundamentals of Electrical Insulation Materials - Electrical Properties of Cable Insulating Materials - Cable Standards and Quality Assurance - Cable design parameters- Current Carrying Capacity - Short-circuit Ratings.

UNIT -III: SUPPLY DISTRIBUTION SYSTEMS AND CABLES**9**

Supply Distribution Systems - Distribution Cable Types, Design and Applications - Paper Insulated Distribution Cables - PVC Insulated Cables - Polymeric Insulated Distribution Cables for 6-30 kV - Manufacture of Distribution Cables - Joints and Terminations for Distribution Cables - Testing of Distribution Cables.

UNIT -IV: TRANSMISSION SYSTEMS AND CABLE

Basic Cable Types for A.C. Transmission - Self-contained Fluid-filled Cables - Gas Pressure Cables - High Pressure Fluid-filled Pipe Cables - Polymeric Insulated Cables for Transmission Voltages - Techniques for Increasing Current Carrying Capacity - Transmission Cable Accessories and Jointing for Pressure-assisted and Polymeric Cables.

UNIT -V: CABLE INSTALLATION, TESTING, MAINTENANCE

9

Installation of Transmission Cables -Splicing, Terminating, and Accessories - Sheath Bonding and Grounding-Testing of Transmission Cable Systems - Underground System Fault Locating -Methods for Cable Fault Identification- Field Assessment of Power Cable Systems- Condition monitoring tests – PD measurements.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Ability to understand the fundamental of underground cable system.
- CO2. Ability to gain knowledge on the architecture of UG cable and physical and electrical characteristics of the UG cable.
- CO3. Ability to understand different types of cable used in distribution system.
- CO4. Ability to acquire knowledge on Underground cables used in transmission system.
- CO5. Ability to understand the cable installations procedures and practices.

TEXT BOOKS:

- T1. William Thue, 'Electrical Power Cable Engineering', CRC Press Taylor & Francis Group., 6000 Broken Sound Parkway NW, Suite 300 Boca Raton, FL 33487-2742, 3rd Edition 2017.
- T2.G. F. Moore, 'Electric Cables Handbook' -Third edition, Blackwell Science Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK., January 2017.

REFERENCES:

- R1 . Leonard L. Grigsby, 'Electrical Power Cable Engineering' - CRC Press, Marcel Dekker, 3rd Edition 2012.
- R2 Christian Flytkjaer Jensen, Online Location of Faults on AC Cables in Underground Transmission Systems (Springer Theses), March 2014.
- R3 <https://kafactor.com/content/technical-resources/kerite-underground-cable-engineering-handbook.pdf>
- R4 Handbook on Cable Fault Localization (April 2020)
[https://rdso.indianrailways.gov.in/works/uploads/File/Handbook%20on %20Cable %20Fault%2 0 Localization\(2\).pdf](https://rdso.indianrailways.gov.in/works/uploads/File/Handbook%20on%20Cable%20Fault%20Localization(2).pdf)
- R5 K. H. Ali et al.:Industry Practice Guide for Underground Cable Fault-Finding in the LVDN:<https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=9807279>, June 2022.

R6 R. W. Deltenre, J. J. Schwarz, and H. J. Wagon, “Underground cable fault location: A handbook to TD-153,” BDM Corp., Albuquerque, NM, USA, Final Rep. EPRI EL-363, 1977. [Online]. Available: <https://www.osti.gov/servlets/purl/7233049>, doi: 10.2172/7233049, January 1997.

COURSE ARTICULATION MATRIX:

PEE102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3	-
CO2	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3	2
CO3	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3	-
CO4	3	2	-	-	-	-	2	1	-	3	2	-	3	-	3	-
CO5	3	2	3	-	-	-	2	1	-	3	2	-	3	3	3	2
Average	3	2	3	-	-	-	2	1	-	3	2	-	3	3	3	2

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. The course aims engineering students to have a holistic understanding of the concepts behind substation engineering and design.
2. The course aims to give an exposure to the students to the requirements of practical aspects including an overview of civil and mechanical aspects.
3. The course aims to enhance the knowledge, and give practical guidelines for site selection, construction, protection along with maintenance, safety in a substation.
4. The course aims to provide knowledge on state-of-the-art technology in substation automation systems.
5. The course aims to provide knowledge about interface engineering in substation automation systems.

UNIT-I: SUBSTATION DESIGN DEVELOPMENT**9**

Substation Introduction and Classifications, Different Types of bus bar switching schemes for Substation. Standards and Practices, Factors Influencing Substation Design - Altitude, Ambient Temperature, Earthquake and seismic zones, pollution and corrosion etc., Testing of Electrical Equipment, Concept and development of Single Line Diagram. Requirement of substation calculation.

UNIT – II: SUBSTATION EQUIPMENT**9**

Selection and sizing of main substation equipment: Selection of Substation Equipments Transformer, Isolator, Circuit Breaker, surge arrestor, Instrument transformers, classification of equipment with a practical overview, and the performance parameters. Classifications of MV Switchgear and Key Design Parameters, MV/LV Switchgear construction and design of control scheme. Station Auxiliary equipment: Diesel Generator System, Basics of AC/DC Auxiliary Power System & Sizing of Aux. Transformer, DC System Components, Battery Sizing & charger Sizing, DG Set Classification, and sizing. Introduction to gas insulated substation: Operating principle of GIS, Advantage over AIS, construction of GIS.

UNIT – III: PROTECTION AND SUBSTATION AUTOMATION

9

Power System protection, Overcurrent and Earth Fault protection and coordination. Distribution Feeder Protection, Transformer – Unit/Main Protection, Familiarization of NUMERICAL Relays, distance/differential protection for transmission line. Substation Automation: Evolution of Substation Automation, Communication System Fundamentals- Protocol fundamental and choosing the right protocol. Substation integration and automation functional architecture, Substation signal list - DI, DO, AI, AO– Bay Control Unit (BCU), Remote Terminal Unit RTU.

UNIT - IV: SUBSTATION DESIGN & LAYOUT ENGINEERING

9

Layout aspects of Outdoor Air Insulated Substation and GIS: Statutory Clearances, Equipment Layout engineering aspects for Outdoor Substation/GIS and related calculations, and guide lines, Cable routing layout, Erection Key Diagram (EKD), switchyard earthing design as per IEEE80, Importance and Types of Earthing, Earthing Design, Types of Earthing Material, Direct stroke Lightning Protection for switchyard with IS/ IEC 62305. LV Cables - Power & Control, MV Cables, Methods for Cable Installation, Practical aspects of Cable Sizing, Cable accessories, Illumination System Design.

UNIT -V: INTERFACE ENGINEERING

9

Civil & Structural Engineering – Interfacing Concepts of Substations - Familiarization of site development plan, equipment supports structures, foundation for equipment, familiarization of control building and substation building, infrastructure development, Mechanical System- Fire Detection, Alarm System and Fire Suppression System for transformer, Heating, Ventilation and Air-conditioning (HVAC) for Substation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Acquiring conceptual clarity in the key deciding factors involved in substation design and operation

- CO2. Interpret fundamental theories of the sizing and selection of equipment which forms part of substation.
- CO3. Recognize the significance of composite layout design aspects of the substation with different services and the challenges including statutory clearances.
- CO4. Identify key concepts of Interdisciplinary aspects involved in substation design.
- CO5. Articulate the basic ideas of substation automation system and different communication protocol involved for efficient operation of a substation.

TEXT BOOKS:

- T1. Sunil S. Rao, "Switchgear Protection and Power Systems (Theory, Practice & Solved Problems)", Khanna Publications, 14th Edition, 2019.
- T2. S. Rao, Electrical substation and engineering & practice, 3rd Edition, Khanna Publishers, 2015.

REFERENCES:

- R1. Manual on Substation by Central Board of irrigation and Power (CBIP) Publication No 342., 2006.
- R2. Substation automation system Design and implementation by Evelio Padilla by Wiley Publications, 1st Edition, November 2015.
- R3. McDonald John D, "Electric Power Substations Engineering", CRC Press, 3rd Edition, 2012.
- R4. Partap Singh Satnam, P.V. Gupta, "Sub-station Design and Equipment", Dhanpat Rai Publications, 1st Edition, 2013.

COURSE ARTICULATION MATRIX:

PEE103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	3	2	-	2	1	3	2	-	-	-	3	3	-	1	-
CO2	3	3	3	3	2	3	-	1	2	-	-	2	3	1	1	2
CO3	3	2	3	3	1	3	-	2	2	-	-	3	3	-	1	-
CO4	3	1	2	-	-	3	2	1	2	-	-	2	3	-	1	-
CO5	3	3	3	3	-	3	2	1	1	-	-	3	3	-	1	2
Average	2.6	2.4	2.6	3.0	1.7	2.6	2.3	1.4	1.8	-	-	2.6	3.0	1.0	1.0	2.0

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. The problems in AC transmission systems and DC transmission systems.
2. The operation and control of SVC and TCSC
3. The concepts of IGBT based FACTS controllers.
4. The basic operation Line Commutated Converter (LCC) based HVDC links
5. The features of voltage source converter based HVDC link.

UNIT-I: INTRODUCTION**9**

Reactive power control in electrical power transmission lines—load & system compensation, Uncompensated transmission line—shunt and series compensation. Need for HVDC Transmission, Comparison between AC & DC Transmission, , Types of HVDC transmission System

UNIT -II: STATIC VAR COMPENSATOR (SVC) AND THYRISTOR CONTROLLED SERIES COMPENSATOR (TCSC)**9**

VI characteristics of FC+TSR, TSC+TSR, Voltage control by SVC—Advantages of slope in dynamic characteristics—Influence of SVC on system voltage—Design of SVC voltage regulator, Thyristor Controlled Series Compensator (TCSC), Concept of TCSC, Operation of the TCSC— Different modes of operation, Applications:

UNIT-III: VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS**9**

Static Synchronous Compensator (STATCOM)—Principle of operation—V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability-prevention of voltage instability. ~~SSSC-operation of SSSC VI characteristics~~, Enhancement in Power transfer capability – UPSC – Operation Principle Applications.

UNIT -IV: LINE COMMUTATED HVDC TRASMISSION**9**

Operation of Gratz bridge - Effect of delay in Firing Angle – Effect of commutation overlap - Equivalent circuit, Basic concept of HVDC transmission. Model of operations and control of power flow CC and CIA mode of operation

Basic 2 level IGBT inverter operation- 4 Quadrant operation- phase angle control- dq control- Control of power flow in VSC based HVDC Transmission, Topologies of MTDC system

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. To Identify and understand the problems in AC transmission systems and understand the need for Flexible AC transmission systems and HVDC Transmission.
- CO2. To understand the operation and control of SVC and TCSC and its applications to enhance the stability and damping.
- CO3. To Analyze basic operation and control of voltage source converter-based FACTS controllers.
- CO4. To demonstrate basic operation and control of Line Commutated HVDC Transmission.
- CO5. : To explain the d-q control-based operation of VSC based HVDC Transmission.

TEXT BOOKS:

- T1. Mohan Mathur, R., Rajiv. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc. 2002
- T2.K.R.Padiyar, "HVDC Power Transmission Systems", McGraw Hill; Second edition (1 November 2020); McGraw Hill Education (India) Private Limited, B-4, Sector-63, Dist. Gautam Budh Nagar, Noida – 201 301, UP

REFERENCES:

- R1. K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution", second edition, New Age International(P) Ltd., Publishers, New Delhi, 2016.
- R2. J.Arrillaga, "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1998.
- R3. S Kamakshaiah, V. Kamaraju "HVDC Transmission" McGraw Hill Education, McGraw Hill Education (1 July 2017)

COURSE ARTICULATION MATRIX:

PEE104	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	1	2	2	3								3		1	
CO2	1	1	3	1	2	1			1		1			2		
CO3	2	2	2	1	3			3		1				1		2
CO4	3	1	2	3	1		1							2		2
CO5	2	1	2	2	3	1						1	2			
Average	2.2	1.2	2.2	1.8	2.4	1	1	3	1	1	1	1	2.5	1.7	1	2

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To understand the concepts of basic needs of energy management
2. To understand the concepts of Energy management on various electrical equipment's and cogeneration
3. To understand the Concept of lighting systems
4. To understand the concepts of Metering for Energy Management
5. To understand the concepts of Economic Analysis and Models

UNIT-I: INTRODUCTION**9**

Basics of Energy – Need for energy management –Commercial and non-commercial energy - Final energy consumption - Energy accounting - Energy monitoring, targeting and reporting - Energy audit process-need of energy audit.

UNIT-II: ENERGY MANAGEMENT FOR MOTORS AND COGENERATION**9**

Energy management for electric motors – Transformer and reactors - Capacitors and synchronous machines, energy management by cogeneration – Forms of cogeneration – Feasibility of cogeneration –Prime Movers for cogeneration Electrical interconnection.

UNIT-III: LIGHTING SYSTEMS**9**

Energy management in lighting systems – Task and the working space - Light sources – Ballasts – Occupancy sensors - Lighting controls – Optimizing lighting energy – Power factor and effect of harmonics, lighting and energy standards.

UNIT-IV: METERING FOR ENERGY MANAGEMENT**9**

Metering for energy management – Units of measure – Typical cost factors - Utility meters – Demand meters – Paralleling of current transformers – Instrument transformer burdens – Multi tasking solid state meters, metering location vs requirements, metering techniques and practical examples.

UNIT-V: ECONOMIC ANALYSIS AND MODELS**9**

Economic analysis – Economic models - Time value of money - Utility rate structures – Cost of electricity – Loss evaluation, load management – Demand control techniques – Utility monitoring and control system – HVAC and energy management – Economic justification.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1. Explain the fundamentals of the energy audit process and its significance.
- CO2. Describe the principles of energy management through cogeneration techniques.
- CO3. Illustrate the methods of energy conservation and management in lighting systems.
- CO4. Analyze energy efficiency practices for various electrical equipment and metering systems.
- CO5. Interpret economic analysis techniques and strategies for effective load management.

TEXT BOOKS:

- T1.L. Ashok Kumar, Gokul Ganesan, "Energy Audit and Management: Concept, Methodologies, Procedures, and Case Studies", CRC Press, 1st Edition, 2023.

REFERENCES:

- R1. Albert Thumann, Terry Niehus, William J. Younger, "Handbook of Energy Audits", CRC Press, 9th Edition, 2020.
- R2. Y. P. Abbi, "Handbook on Energy Audit and Environment Management", TERI Press, 1st Edition, 2016.

COURSE ARTICULATION MATRIX:

PEE105	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1			2		3			1						
CO2	1		3		1				1			2				
CO3		2		3		1										
CO4			3					1			3					
CO5		2			1			3	2			2				
Average	1.5	1.7	3.0	3.0	1.3	1.0	3.0	2.0	1.5	1.0	3.0	2.0				

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To study the various sources and effects of power quality issues
2. To introduce different mitigation techniques of various power quality events
3. To impart knowledge of various sources & mitigation of harmonics
4. To learn the Various Active & Passive power filters
5. To study the various power quality monitoring and custom power devices

UNIT-I: INTRODUCTION**9**

Terms and definitions & Sources – Characteristics of Electric Power Quality- Overloading, under voltage, over voltage - Linear and Non-linear load, Concepts of transients - Short duration variations such as interruption - Long duration variation such as sustained interruption - Sags and swells - Voltage sag - Voltage swell - Voltage imbalance –Voltage fluctuations - Power frequency variations - International standards of power quality– Computer Business Equipment Manufacturers Associations (CBEMA) curve- Power Quality issues of Grid connected Renewable Energy Sources

UNIT-II: VOLTAGE SAG AND SWELL**9**

Estimating voltage sag performance - Thevenin's equivalent source - Analysis and calculation of various faulted condition - Estimation of the sag severity - Mitigation of voltage sag, Static transfer switches and fast transfer switches. - Capacitor switching – Lightning - Ferro resonance - Mitigation of voltage swells.

UNIT-III: HARMONICS**9**

Principle of Harmonic Filters – Series - Tuned Filters- Double Band –Pass Filters-Harmonic sources from commercial and industrial loads - Locating harmonic sources – Power system response characteristics - Harmonics Vs transients. Effect of harmonics – Harmonic distortion - Voltage and current distortions - Harmonic indices - Inter harmonics, IEEE and IEC standards.

UNIT-IV: PASSIVE POWER COMPENSATORS**9**

Principle of Operation of Passive Shunt and Series Compensators- Series Active Filters - Analysis and Design of Passive Shunt Compensators Simulation and Performance of Passive Power Filters- Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System and Its Mitigation, Fundamentals of load compensation – voltage regulation & power factor correction.

UNIT-V: POWER QUALITY MONITORING & CUSTOM POWER DEVICES**9**

Monitoring considerations - Monitoring and diagnostic techniques for various power quality problems - Quality measurement equipment – Assessment of power quality measurement data- Harmonic / spectrum analyzer - Flicker meters Disturbance analyzer - Applications of expert systems for power quality monitoring. Principle& Working of DSTATCOM – DSTATCOM in Voltage control mode, current control mode, DVR Structure – Rectifier supported DVR – DC Capacitor supported DVR -Unified power quality conditioner.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1. Explain the sources and effects of various power quality (PQ) issues in electrical systems.
- CO2. Analyze different mitigation techniques for addressing power quality disturbances.
- CO3. Describe the sources of harmonics and evaluate methods for their mitigation.
- CO4. Analyze and design both active and passive power filters for power quality improvement.
- CO5. Explain power quality monitoring techniques and the role of custom power devices.

TEXT BOOKS:

- T1. Simmi P. Burman, Bipin Singh, “Power Quality”, S.K. Kataria & Sons, 2nd Edition, Reprint 2025.
- T2. Ewald F. Fuchs, Mohammad A. S. Masoum, “Power Quality in Power Systems, Electrical Machines, and Power-Electronic Drives”, Academic Press (Elsevier), 3rd Edition, 2023.

REFERENCES:

- R1. Sanjeevikumar Padmanaban, “Power Quality in Modern Power Systems”, Academic Press, 1st Edition, 2020.
- R2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, “Electrical Power Systems Quality”, McGraw Hill, 3rd Edition, 2012.
- R3. Mahesh Kumar Mishra, “Power Quality in Power Distribution Systems: Concepts and Applications”, CRC Press (Routledge), 1st Edition, 2021.

COURSE ARTICULATION MATRIX:

PEE106	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1						1	1									
CO2	3		3		3							2		3	3	
CO3		3	3	3	3							2		3	3	
CO4	1	3	3	3	3									3	3	2
CO5		2	3					1			1			1	1	
Average	2.0	2.7	3.0	3.0	3.0	1.0	1.0	1.0			1.0	2.0		2.5	2.5	2.0

COURSE OBJECTIVES:

1. To understand the working and control of stepper motor.
2. To analyze the working, control and performance of switched reluctance motor.
3. To acquire knowledge on Construction, torque equation and control of BLDC motor.
4. To learn the working of PMSM and to study the working principle of synchronous reluctance motor.
5. To understand the construction, principle of operation and performance of other special Machines.

UNIT-I: STEPPER MOTORS**9**

Constructional features –Principle of operation –Types – Torque predictions – Linear and Non-linear analysis – Characteristics – Phasor Diagram-Drive circuits – Closed loop control – Applications.

UNIT-II: SWITCHED RELUCTANCE MOTORS**9**

Constructional features –Principle of operation- Torque prediction–Effect of airgap on torque - Characteristics-Power controllers –Control of SRM drive- Speed control-current control- - design procedures- Sensor less operation of SRM – Current sensing-rotor position measurement and estimation methods- sensor less rotor position estimation–applications.

UNIT-III: PERMANENT MAGNET BRUSHLESS DC MOTORS**9**

Fundamentals of Permanent Magnets- Types- Principle of operation- Magnetic circuit analysis EMF and Torque equations- Characteristics- Controller Design-Transfer function – Machine, Load and Inverter - Introduction to design using ANSYS Maxwell Software.

UNIT-IV: PERMANENT MAGNET SYNCHROUNOUS MOTORS**9**

Permanent Magnet ac Machines, PMSM - Principle of operation -Ideal PMSM – EMF and Torque equations - Phasor diagram - Torque speed characteristics –evaluation of control characteristics- design of current and speed controllers- Constructional features, operating principle and characteristics of synchronous reluctance motor.

UNIT-V: STUDY OF OTHER SPECIAL ELECTRICAL MACHINES**9**

Principle of operation and characteristics of Hysteresis motor – AC series motors – Linear motor –Universal Motor - Applications.

COURSE OUTCOMES:

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

- CO1. Acquire the knowledge on construction and operation of stepper motor.
- CO2. Acquire the knowledge on construction and operation of stepper switched reluctance motors.
- CO3. Acquire the knowledge on construction and operation of permanent magnet brushless D.C. motors.
- CO4. Acquire the knowledge on construction and operation of permanent magnet synchronous motors and synchronous reluctance motor.
- CO5. Understand the operation and characteristics of other special electrical machines.

TEXT BOOKS:

- T1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2021.
- T2. Akira Sugawara, T.Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 2017
- T3. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014

REFERENCES:

- R1. Jacek F. Gieras, Dr. Rong-Jie Wang, Professor Maarten J. Kamper - Axial Flux Permanent Magnet Brushless Machines-Springer Netherlands 2014.
- R2. Bilgin, Berker Emadi, Ali Jiang, James Weisheng - Switched reluctance motor drives: fundamentals to applications-CRC 2019.
- R3. Ramu Krishnan - Permanent Magnet Synchronous and Brushless DC Motor Drives - CRC Press,Marcel Applications -CRC Press 2009.
- R4. R. Krishnan - Switched Reluctance Motor Drives Modeling, Simulation, Analysis, Design, and Applications -CRC Press 2017.

COURSE ARTICULATION MATRIX:

PEE201	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	2		3	2				3	3	1		
CO2	3	3	3	3	2		3	2				3	2	1		
CO3	3	3	3	3	2		3	2				3	2	1		
CO4	3	3	3	3	2		3	2				3	2	1		
CO5	3	3	3	3	2		3	2				3	2	1		
Average	3	3	3	3	2		3	2				3	2.2	1		

COURSE OBJECTIVES:

1. To model & simulate all types of DC machines
2. To develop reference frame equations for various elements like R, L and C
3. To model an induction (three phase and 'n' phase) and synchronous machine
4. To derive reference frame equations for induction and synchronous machine
5. To study the need and working of multiphase induction and synchronous machine

UNIT-I: MODELING OF BRUSHED-DC ELECTRIC MACHINERY**9**

Fundamentals of Operation – Introduction – Governing equations and modeling of Brushed DC-Motor –Shunt, Series and Compound – State model derivation – Construction of Model of a DC Machine using state equations- Modelling and Analysis of PM DC motor using FEM.

UNIT-II: REFERENCE FRAME THEORY**9**

Historical background – phase transformation and commutator transformation – transformation of variables from stationary to arbitrary reference frame -Linear Transformation – Phase Transformation.

UNIT-III: INDUCTION MACHINES**9**

Three phase induction machine - equivalent circuit– free acceleration characteristics – voltage and torque equations in machine variables and arbitrary reference frame variables – Analysis of dynamic performance for load torque variations - Simulation under no load and load conditions

UNIT-IV: SYNCHRONOUS MACHINES**9**

Three phase synchronous machine - voltage and torque equations in machine variables and rotor reference frame variables (Park's equations) - Analysis of dynamic performance for load torque variations.

UNIT-V: MULTIPHASE (MORE THAN THREE-PHASE) MACHINES CONCEPTS**9**

Preliminary Remarks - Necessity of Multiphase Machines - Evolution of Multiphase Machines - Advantages of Multiphase Machines - Working Principle - Multiphase Induction Machine, Multiphase Synchronous Machine - Applications of Multiphase Machines

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Find the modeling for a brushed DC-Motor (Shunt, Series, Compound and separately excited motor)
- CO2. Apply reference frame theory for, resistive and reactive elements (three phase).
- CO3. Compute the equivalent circuit and torque of three phase induction motor and synchronous motor in machine variable arbitrary reference frame variable.
- CO4. Demonstrate the working of synchronous motor, voltage and torque equations and compute the model.
- CO5. Compute the working of multiphase induction and synchronous machine and to find the need and advantages of multiphase machines.

TEXT BOOKS:

- T1. R. Krishnan, Electric Motor & Drives: Modeling, Analysis and Control, Pearson Education, 1st Imprint, 2015, 1st Edition.
- T2. Stephen D. Umans, "Fitzgerald & Kingsley's Electric Machinery", Tata McGraw Hill, 7th Edition, 2020.
- T3. Chee Mun Ong, Dynamic Simulation of Electric Machinery using MATLAB, Prentice Hall, 1997, 1st Edition.

REFERENCES:

- R1. Bogdan M. Wilamowski, J. David Irwin, The Industrial Electronics Handbook, Second Edition, Power Electronics and Motor Drives, CRC Press, 2011, 1st Edition.
- R2. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, Steven D. Pekarek, "Analysis of Electric Machinery and Drive Systems", 3rd Edition, Wiley-IEEE Press, 2013.
- R3. Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Wiley, 2021, 1st Edition

COURSE ARTICULATION MATRIX:

PEE202	PO								PSO							
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3		3		3	3	1		2	3	1		2
CO2	3	3	2	3		2		3	3	1		2	3	1		2
CO3	3	3	2	2		3		3	3	1		2	3	1		2
CO4	3	3	3	2		2		3	3	1		2	3	1		2
CO5	3	3	3	3		2		3	3	1		2	3	1		2
Average	3	3	2.6	2.6		2.4		3	3	1		2	3	1		2

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To learn multilevel topology (Symmetry & Asymmetry) with common DC bus link.
2. To get the insight of Cascaded H-Bridge Multilevel inverters.
3. To provide knowledge about Diode clamped multilevel inverters.
4. To understand the fundamental concepts of Flying capacitor multilevel inverters.
5. To understand the concepts of Modular multilevel inverters.

UNIT-I: MULTILEVEL TOPOLOGIES**9**

Introduction – Generalized Topology with a Common DC bus – Converters derived from the generalized topology – symmetric topology without a common DC link – Asymmetric topology.

UNIT -II: CASCADED H-BRIDGE MULTILEVEL INVERTERS**9**

Introduction -H-Bridge Inverter, Bipolar Pulse Width Modulation, Unipolar Pulse Width Modulation. Multilevel Inverter Topologies, CHB Inverter with Equal DC Voltage, H-Bridges with Unequal DC Voltages – PWM, Carrier-Based PWM Schemes, Phase-Shifted Multicarrier Modulation, Level Shifted Multicarrier Modulation, Comparison Between Phase- and Level-Shifted PWM Schemes-Staircase Modulation.

UNIT -III: DIODE CLAMPED MULTILEVEL CONVERTER**9**

Introduction – Converter structure and Functional Description – Modulation of Multilevel converters– Voltage balance Control – Effectiveness Boundary of voltage balancing in DCMC converters -Performance results.

UNIT -IV: FLYING CAPACITOR MULTILEVEL CONVERTER**9**

Introduction – Flying Capacitor topology – Modulation scheme for the FCMC – Dynamic voltage balance of FCMC-Multilevel inverter with reduced switch count-structures, working principles and pulse generation methods.

UNIT -V: MODULAR MULTILEVEL CONVERTERS**9**

Basics of cascaded half-bridge and full-bridge modules, Control aspects of the modular multilevel converter, Circulating current control, Control of grid connected modular multilevel converter, Control of the MMC for High-Voltage DC (HVDC) transmission.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Examine the different topologies of multilevel inverters (MLIs) with and without DC link capacitor.
- CO2. Examine the performance of MLIs with Bipolar Pulse Width Modulation (PWM) Unipolar PWM Carrier-Based PWM Schemes Phase Level Shifted Multicarrier Modulation
- CO3. Demonstrate the working principles of Cascaded H-Bridge MLI, diode clamped MLI, flying capacitor MLI and MLI with reduced switch count
- CO4. Analyze the voltage balancing performance in Diode clamped MLI.
- CO5. Learners will attain knowledge about Modular Multilevel Power converter

TEXT BOOKS:

- T1. Rashid M.H, "Power Electronics Circuits, Devices and Applications", Prentice Hall India, Third Edition, New Delhi, 2017 Pearson 4th edition.
- T2. Sergio Alberto Gonzalez, Santiago Andres Verne, Maria Ines Valla, "Multilevel Converters for Industrial Applications", CRC Press, 22-Jul-2013, 2017 1st Edition.
- T3. Bin Wu, Mehdi Narimani, High Power Converters and AC drives by IEEE press 2017, 2nd Edition.

REFERENCES:

- R1 Thomas A. Lipo, Pulse Width Modulation for Power Converters: Principles and Practice, D. Grahame Holmes, John Wiley & Sons, Oct-2003, 1st Edition.
- R2 Fang Lin Luo, Hong Ye, Advanced DC/AC Inverters: Applications in Renewable Energy, CRC Press, 22-Jan-2013, 2017, 1st Edition.
- R3 Hani Vahedi, Mohamed Trabelsi, Single-DC-Source Multilevel Inverters, Springer, 2019, 1st Edition.
- R4 Ersan Kabalcı, Multilevel Inverters Introduction and Emergent Topologies, Academic Press Inc, 2021, 1st Edition.
- R5 Iftexhar Maswood, Dehghani Tafti, Advanced Multilevel Converters and Applications in Grid Integration, Wiley, 2018, 1st Edition.

COURSE ARTICULATION MATRIX:

PS3162	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	2	3			2	1		3		3	3		3	
CO2	3	2	2	3			2	1		3		3	3	2		
CO3	3	2	2	3			2	1		3		3	3	2		
CO4	3	3	3	3			2	1		3		3	3			
CO5	3	3	3	3	3		2	1		3		3	3			
Average	3	2.4	2.4	3	3		2	1		3		3	3	2	3	

COURSE OBJECTIVES:

1. To understand steady state operation and transient dynamics of a motor load system.
2. To study and analyze the operation of the converter/chopper fed DC drive, both qualitatively and quantitatively.
3. To study and understand the operation and performance of AC motor drives.
4. To study and analyze the SRM and BLDC motor drive control.
5. To analyze and design digital control for drives.

UNIT-I: DRIVE CHARACTERISTICS**9**

Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, starting & stopping – typical load torque characteristics – Selection of motor, modes of operation.

UNIT -II: CHOPPER FED DC MOTOR DRIVE**9**

Steady state analysis of the single and three phase converter fed separately excited DC motor drive – continuous and discontinuous conduction – Time ratio and current limit control – four quadrant operations of converter / chopper fed drive.

UNIT -III: INDUCTION MOTOR DRIVES**9**

Stator voltage control – energy efficient drive – v/f control – constant air gap flux –field weakening mode – Voltage / current fed inverter – closed loop control-slip power recovery scheme.

UNIT -IV: CONTROL OF SRM AND BLDC MOTOR DRIVES**9**

SRM construction - Principle of operation - Block diagram of Instantaneous Torque control using current controllers and flux controllers. Construction and Principle of operation of BLDC Machine - Block diagram of current controlled Brushless dc motor drive.

UNIT -V: DIGITAL CONTROL OF DC DRIVE**9**

Phase Locked Loop and micro-computer control of DC drives – Program flow chart for constant torque and constant horse power operations - Speed detection and current sensing circuits and feedback elements.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon the successful completion of the course, students will have the:

- CO1. Ability to understand drive characteristics.
- CO2. Ability to understand chopper fed drive.
- CO3. Ability to understand induction motor drives.
- CO4. Ability to understand various control strategies and controllers for SRM & BLDC Motor Drive systems.
- CO5. Ability to design digital control for drives.

TEXT BOOKS:

- T1. Gopal K.Dubey, Fundamentals of Electrical Drives, Narosa Publishing House, 2nd Edition, Reprinted 2022.
- T2. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, Reprinted 2022.

REFERENCES:

- R1. John Hindmarsh and Alasdain Renfrew, "Electrical Machines and Drives System," Elsevier, 2024.
- R2. Shaahin Felizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2025.
- R3. S.K.Pillai, A First course on Electrical Drives, Wiley Eastern Limited, 4th Edition 2022.
- R4. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives," CRC press, 2025.

COURSE ARTICULATION MATRIX:

PEE204	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	2	1					1				1	1			
CO2	2	3	2		2		1						2	3	2	1
CO3	2	2	2			1			3				3			1
CO4	2	3	3	1				1		2			3		2	1
CO5	3	2	2	2								1	3	2		1
Average	2.4	2.4	2	1.5	2	1	1	1	3	2		1	2.4	2.5	2	1

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. Modern power electronic converters and its applications in electric power utility.
2. Resonant converters and UPS.
3. To learn the Switched Mode Power Converters.
4. To learn the DC-DC converters & DC-AC converters.
5. To learn the Power conditioners & Filters.

UNIT-I: DC-DC CONVERTERS**9**

Principles of step down and step up converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk Converters-Different Class of Chopper.

UNIT -II: SWITCHED MODE POWER CONVERTERS**9**

Analysis and state space modeling of fly back, Forward, Push pull, Luo, Half bridge and full bridge converters - control circuits and PWM techniques.

UNIT -III: RESONANT CONVERTERS**9**

Introduction- classification- basic concepts- Resonant switch- Load Resonant converters- ZVS, Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.

UNIT -IV: DC-AC CONVERTERS**9**

Single phase and three phase inverters, control using various (sine PWM, SVPWM and PSPWM) techniques, various harmonic elimination techniques- Multilevel inverters Concepts.

UNIT -V: POWER CONDITIONERS, UPS & FILTERS**9**

Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors and Selection of capacitors.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Ability to analyze the state space model for DC – DC converters.
- CO2. Ability to acquire knowledge on switched mode power converters.
- CO3. Ability to understand the importance of Resonant Converters.
- CO4. Ability to analyze the PWM techniques for DC-AC converters.
- CO5. Ability to acquire knowledge on modern power electronic converters, power conditioners and UPS.

TEXT BOOKS:

- T1. M.H. Rashid – Power Electronics handbook, Elsevier Publication, 2024.
- T2. Simon Ang, Alejandro Oliva, "Power-Switching Converters", Third Edition, CRC Press, 2023.

REFERENCES:

- R1. Philip T Krein, "Elements of Power Electronics", Oxford University Press. Second Edition, 2017.
- R2. Erickson, Robert W, "Fundamentals of Power Electronics", Springer, second edition, 2020.
- R3. M.H. Rashid – Power Electronics circuits, devices and applications- third edition Prentice Hall of India New Delhi, 2017.
- R4. Ned Mohan, Tore.M.Undeland, William.P.Robbins, Power Electronics converters, Applications and design- Third Edition- John Wiley and Sons -2017.

COURSE ARTICULATION MATRIX :

PEE205	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1				1		3	1	1	2			3		1	
CO2	2	2	2	1		2					2	2		1		2
CO3		2	2		1			2		1			1	2		2
CO4	3			2		1	2		2		3	1			2	
CO5	2	1	3		1			1		1			2	1		1
Average	2	1.7	2.3	1.5	1	1.5	2.5	1.3	1.5	1.3	2.5	1.5	2	1.3	1.5	1.7

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To learn the various types of renewable sources of energy.
2. To analyze the electrical machines to be used for wind energy conversion systems.
3. To learn the principles of power converters used in solar PV system.
4. To study the principle of power converters used in Wind system.
5. To simulate the AC-DC, AC-AC Converters, Matrix Converters and PWM Inverters.

UNIT-I: INTRODUCTION TO RENEWABLE ENERGY SYSTEMS 9

Classification of Energy Sources – Importance of Non-conventional energy sources – Advantages and disadvantages of conventional energy sources - Environmental aspects of energy - Impacts of renewable energy generation on the environment - Qualitative study of renewable energy resources: Ocean energy, Biomass energy, Hydrogen energy, - Tidal Energy: Types, Operating Principles, Control methods, Solar Photovoltaic (PV), Fuel cells: Operating principles and characteristics, Wind Energy: Nature of wind, Types, control strategy, operating area.

UNIT -II: ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS 9

Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG) - Control methods of wind Energy Conversion Systems (WECS).

UNIT -III: POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS 9

Power Converters: Line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. Simulation of line commutated converters, buck/boost converters. Analysis: Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems, Grid integrated solar PV Systems - Grid Connection Issues - Solar Powered Microgrid.

UNIT -IV: POWER CONVERTERS FOR WIND SYSTEMS 9

Power Converters: Three-phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, Controlled rectifiers, PWM Inverters, Grid-Interactive Inverters - Matrix converter.

UNIT -V: HYBRID RENEWABLE ENERGY SYSTEMS**9**

Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Diesel-PV, Wind-PV, Micro hydel-PV, Biomass-Diesel systems - Maximum Power Point Tracking (MPPT) – Control methods of MPPT.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

CO1: Examine the available renewable energy sources.

CO2: Demonstrate the working principles of electrical machines and power converters used for wind energy conversion system

CO3: Demonstrate the principles of power converters used for solar PV systems

CO4: Examine the available hybrid renewable energy systems.

CO5: Simulate AC-DC converters, buck/boost converters, AC-AC converters and PWM inverters.

TEXT BOOKS:

T3.Rai. G.D, "Non-conventional energy sources", Khanna publishers, 6th Edition, 2017.

T4.H.Khan "Non-conventional Energy sources ", Tata McGraw-hill Publishing Company, New Delhi, 2017.

REFERENCES:

R1. Rashid.M. H "Power electronics Hand book", Academic press,2nd Edition, 2006 4th Edition, 2017.

R2.S.N.Bhadra, D. Kastha, & S. Banerjee "Wind Electrical Systems", Oxford University Press, 2009, 7th impression.

R3.Rai. G.D," Solar energy utilization", Khanna publishers, 5th Edition, 2008.

R4.Gray, L. Johnson, "Wind energy system", prentice hall of india, 2nd Edition, 2006.

COURSE ARTICULATION MATRIX:

PEE206	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		2							2		2		3	3	3
CO2	3		2							2		2		3	3	3
CO3	3		2							2		2		3	3	3
CO4	3		3							2		2		3	3	3
CO5	3	3	2	3	3			3		2		3		3	3	3
Average	3	3	2.2	3	3			3		2		2.2		3	3	3

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To provide knowledge on the basics, building blocks of Embedded System.
2. To discuss Input/output Interfacing & Bus Communication with processors.
3. To teach automation using scheduling algorithms and Real time operating system.
4. To discuss on different Phases & Modeling of a new embedded product.
5. To involve Discussions/ Practice/Exercise onto revising & familiarizing the concepts

UNIT-I: INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems –built in features for embedded Target Architecture - selection of Embedded processor – DMA- memory devices – Memory management methods- memory mapping, cache replacement policies- Timer and Counting devices, Watchdog Timer, Real Time Clock Software Development tools-IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging- Overview of functional safety standards for embedded systems.

UNIT-II: EMBEDDED NETWORKING BY PROCESSORS 9

Embedded Networking: Introduction, I/O Device Ports & Buses- multiple interrupts and interrupt service mechanism – Serial Bus communication protocols -RS232 standard–RS485– USB–Inter Integrated Circuits (I2C)- CAN Bus –Wireless protocol based on Wifi , Bluetooth, Zigbee – Introduction to Device Drivers.

UNIT-III: RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS- Need, Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication -context switching, interrupt latency and deadline shared memory, message passing-, Interprocess Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, uC/OS-II, RT Linux.

UNIT-IV: MODELLING WITH HARDWARE/SOFTWARE DESIGN APPROACHES 9

Modelling embedded systems- embedded software development approach --Overview of UML modeling with UML, UML Diagrams-- Hardware/Software Partitioning, Co-Design Approaches for System Specification and modeling- CoSynthesis- features comparing Single-

processor Architectures & Multi-Processor Architectures--design approach on parallelism in uniprocessors & Multiprocessors.

UNIT-V: EMBEDDED SYSTEM APPLICATION DEVELOPMENT

9

Objective, Need, different Phases & Modelling of the EDLC. Choice of Target Architectures for Embedded Application Development-for Control Dominated-Data Dominated Systems-Case studies on Digital Camera, Adaptive Cruise control in a Car, Mobile Phone software for key inputs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Apply the functionalities of processor internal blocks and their associated requirements
- CO2. Analyze how bus standards are chosen based on interface overheads without sacrificing processor performance.
- CO3. Analyze the role and features of an RTOS (Real-Time Operating System) that enables multitasking execution by processors.
- CO4. Apply the concepts of multiple CPUs, whether hardcore or softcore, to manage data overhead and optimize processing speed for microcontroller execution.
- CO5. Design embedded consumer products following the phases of product development.

TEXT BOOKS

- T1. Elecia White, "Making Embedded Systems: Design Patterns for Great Software", O'Reilly Media, Second Edition, 2024.
- T2. Shibu. K.V, "Introduction to Embedded Systems", 2e, Mc graw Hill, 2016.

REFERENCE BOOKS

- R1. Raj Kamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.
- R2. C.R.Sarma, "Embedded Systems Engineering", University Press (India) Pvt. Ltd, 2013.
- R3. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
- R4. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.
- R5. Arnold S. Berger – "Embedded System Design", CMP books, USA 2002.
- R6. Giovanni De Micheli, Mariagiovanna Sami , Hardware / Software Co- Design, Kluwer Academic Publishers , 2002

- R7. Tammy Noergaard, Embedded System Architecture, A comprehensive Guide for Engineers and Programmers”, Elsevier, 2006
- R8. Bruce Powel Douglass,”Real-Time UML Workshop for Embedded Systems, Elsevier,2011.
- R9. Peckol, “Embedded system Design”, John Wiley & Sons,2019.

COURSE ARTICULATION MATRIX:

PEE301	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1			3	2	1											
CO2	2		1													
CO3		2	2	1												
CO4	2		3	2												
CO5	2		1	2		2										
Average	2	2	2	1.8	1	2										

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To expose the students to the fundamentals of embedded Programming
2. To Introduce the GNU C Programming Tool Chain.
3. To study the basic concepts of embedded C.
4. To teach the basics of 8051 Programming
5. To involve Discussions/ Practice/Exercise in revising & familiarizing the concepts acquired over the 5 Units of the subject for improved employability skills.

UNIT-I: BASIC C PROGRAMMING**9**

Typical C Program Development Environment - Introduction to C Programming – Structured Program Development in C - Data Types and Operators - C Program Control - C Functions - Introduction to Arrays.

UNIT -II: EMBEDDED C**9**

Adding Structure to 'C' Code: Object-oriented programming with C, Header files for Project and Port, Examples. Meeting Real-time constraints: Creating hardware delays - Need for timeout mechanism - Creating loop timeouts - Creating hardware timeouts.

UNIT -III: 8051 PROGRAMMING IN C**9**

Data types and time delay in 8051, I/O programming in 8051, Logic operations in 8051, Data conversion program in 8051 Accessing code ROM space in 8051, Data serialization using 8051

UNIT -IV: 8051 SERIAL PORT AND INTERRUPT PROGRAMMING IN C**9**

Basics of serial communication, 8051 interface to RS232- serial port programming in 8051. 8051 interrupts and programming, Programming for timer configuration.

UNIT -V: 8051 INTERFACING**9**

8051: ADC interfacing, DAC interfacing, Sensor interfacing, LCD interfacing, Stepper motor interfacing, DC motor interfacing and PWM.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

- CO1. Apply embedded C programming and utilize its key features for embedded systems.

- CO2. Analyze the software and hardware architecture for distributed computing in embedded Systems
- CO3. Develop a solution for problems by using the concept learned in programming using the embedded controllers
- CO4. Develop simple applications with 8051 by using its various features and interfacing with various external hardware.
- CO5. Improved Employability and entrepreneurship capacity due to knowledge upgradation on recent trends in embedded programming skills.

TEXT BOOKS:

- T1. Paul Deitel and Harvey Deitel, "C How to Program", 9th Edition, Pearson Education Limited, 2022, 1st edition.
- T2. Michael J Pont, "Embedded C", Addison-Wesley, An imprint of Pearson Education, 2002.
- T3. William von Hagen, "The Definitive Guide to GCC", 2nd Edition, Apress Inc., 2006.

REFERENCES:

- R1. Noel Kalicharan, "Learn to Program with C", Apress Inc., 2015, 1st edition.
- R2. Gowrishankar S and Veena A, "Introduction to Python Programming", CRC Press, Taylor & Francis Group, 2019.
- R3. Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, 'The 8051 Microcontroller and Embedded Systems' Prentice Hall, 2nd Edition 2007.
- R4. Myke Predko, "Programming and customizing the 8051microcontrollers", McGraww Hill 2000, 1st edition.

COURSE ARTICULATION MATRIX:

PEE302	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1	2	3	1								1	2	2	1
CO2	1	1	2	2	1								1	3	2	1
CO3	2	2	3	2	3								2	3	3	2
CO4	3	2	3	2	3								1	1	1	1
CO5	3	2	1	2	1				1				2	3	2	2
Average	2	1.6	2.2	2.2	1.8				1				1.4	2.4	2	1.4

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To analyze the features of various embedded processors.
2. To analyze the On-chip peripherals.
3. To develop ARM processor-based applications.
4. To design innovative applications by interfacing the processors with real world.
5. To analyze and develop various ARM cortex processors

UNIT-I: INTRODUCTION TO EMBEDDED PROCESSORS**9**

Introduction to embedded processors– Compare Von Neumann architecture and Harvard architecture, RISC Vs CISC – System on Chip (SoC)-Introduction to SoC Architecture, An approach for SOC Design, System Architecture and Complexity. Processor Selection for SOC, Basic concepts in Processor Architecture, Overview of SOC external memory, Internal Memory, Scratchpads and Cache memory, SOC Memory System, Models of Simple Processor – memory interaction, SOC Standard Buses

UNIT-II EMBEDDED PROCESSORS ON CHIP PERIPHERALS**9**

Memory - Interrupts - I/O Ports-Timers & Real Time Clock (RTC), Watch dog timer - CCP modules - Capture Mode - Compare Mode-PWM Mode –Synchronous and Asynchronous communication- Serial communication module - USART - SPI interface I²C interface, Analog Comparator, Analog interfacing and data acquisition.

UNIT-III: ARM PROCESSOR**9**

Architecture of ARM Controller – Registers, Pipeline organization 3 stage & 5 stage, Thumb mode of operation - D/A and A/D converter, sensors, actuators and their interfacing – Case study- Digital clock, Temperature sensing, Light sensing, Introduction to Internet of Things, smart home concepts-simple ARM programming.

UNIT-IV: REAL WORLD INTERFACING USING ARM PROCESSOR**9**

Interfacing the peripherals to LPC2148: GSM and GPS using UART, on-chip ADC using interrupt (VIC), EEPROM using I2C, SD card interface using SPI, on-chip DAC for waveform generation.

UNIT-V: ARM CORTEX PROCESSORS

9

Introduction to ARM CORTEX series, improvement over classical series and advantages for embedded system design. CORTEX A, CORTEX M, CORTEX R processors series, versions, features and applications, need of operating system in developing complex applications in embedded system, Firmware development for ARM Cortex, Survey of CORTEX M3 based controllers, its features and comparison.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Analyze the architecture of different embedded processors.
- CO2. Identify appropriate on-chip peripherals for serial and parallel communication.
- CO3. Develop real-time applications using ARM processors.
- CO4. Design firmware for embedded applications.
- CO5. Develop innovative products using embedded processors.

TEXT BOOKS

- T1. F. Vahid and T. Givargis, "Embedded System Design: A Unified Hardware/Software Introduction", 3rd Edition, Wiley, 2011.
- T2. Michael J. Flynn and Wayne Luk, "Computer System Design: System-on-Chip", 1st Edition, Wiley India Pvt. Ltd., 2011.
- T3. Steve Furber, "ARM System on Chip Architecture ", 2nd Edition, Addison Wesley Professional, 2000.

REFERENCE BOOKS

- R1. Mark Fisher, "ARM Cortex M4 Cookbook", Packt Publishing, 2016.
- R2. Lyla B. Das, "Architecture, Programming and Interfacing of Low-power Processors ARM 7, Cortex-M", Cengage, 1st Edition, 2017.
- R3. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M3", Newness, 2nd Edition, 2009
- R4. S. Pascricha and N. Dutt, Morgan Kaufmann, On-Chip Communication Architectures, System on Chip Interconnect, -Elsevier Publishers 2008.

COURSE ARTICULATION MATRIX:

PEE303	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	3	2	3											
CO2	2	3	2	1	3											
CO3	2	3	2	1	2											
CO4	3	2	2	2	2											
CO5	3	3	2	2	2											
Average	2.4	2.6	2.2	1.6	2.4											

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To provide the control concept for electrical drives.
2. To emphasis the need for embedded system for controlling the electrical drives.
3. To provide knowledge about various embedded system-based control strategy for electrical drives
4. To Impart the knowledge of optimization and machine learning techniques used for electrical drives
5. To familiarize the high-performance computing for electrical drives.

UNIT-I: INTRODUCTION ELECTRICAL DRIVES 9

Electric drive and its classifications, Four-quadrant drive, Dependence of load torque on various factors, Dynamics of motor-load combination-Solid State Controlled Drives-Machine learning and optimization techniques for electrical drives- IoT for Electrical drives applications.

UNIT-II: OVERVIEW OF EMBEDDED PROCESSOR 9

Embedded Processor architecture-RTOS – Hardware/software co-design-Programming with SoC processors.

UNIT-III: INDUCTION MOTOR CONTROL 9

Types- Speed control methods-PWM techniques- VSI fed three-phase induction motor- Fuzzy logic Based speed control for three phase induction motor-FPGA based three phase induction motor control.

UNIT-IV: BLDC MOTOR CONTROL 9

Overview of BLDC Motor -Speed control methods -PWM techniques- ARM processor based BDLC motor control-DSP based BDLC motor control-ANN for BLDC Motor control and operation.

UNIT-V: SRM MOTOR CONTROL 9

Overview of SRM Motor -Speed control methods -PWM techniques- FPGA based SRM motor control- DSP based SRM motor control DNN for SRM Motor control and operation.

COURSE OUTCOMES:

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

- CO1. Analyze the significance of embedded control in electrical drives
- CO2. Analyze various control strategies for electrical drives and deliver insights into their applications.
- CO3. Apply machine learning and optimization techniques to develop knowledge for motor control.
- CO4. Create embedded system solutions for real-time applications such as electric vehicles and UAVs
- CO5. Apply recent trends in embedded system skills for motor control strategy to improve employability and entrepreneurship capacity.

TEXT BOOKS

- T1. R.Krishnan, "Electric Motor Drives – Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltd., New Delhi, 2001.
- T2. Raj Kamal, "Embedded Systems: Architecture, Programming, and Design", 3rd Edition, McGraw-Hill Education, 2017.

REFERENCE BOOKS

- R1. Steve Furber, 'ARM system on chip architecture', Addison Wesley, 2000.
- R2. Ron Sass and Andrew G. Schmidt, "Embedded System design with platform FPGAs: Principles and Practices", Elsevier, 2010.
- R3. Steve Kilts, "Advanced FPGA Design: Architecture, Implementation, and Optimization" Willey, 2007
- R4. Vedam Subrahmanyam, "Electric Drives – Concepts and Applications", 2nd Edition, Tata McGraw-Hill Education, New Delhi, 2011.
- R5. K. Venkataratnam, "Special Electrical Machines", eBook Edition, Universities Press (India) Pvt. Ltd., 2021.

COURSE ARTICULATION MATRIX:

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1		2		2											
CO2	1	1	3			2										
CO3	2				3											
CO4	1	2	3	1												
CO5					3											
Average	1.3	1.5	2.7	1	2.7	2										

COURSE OBJECTIVES:

1. To impart knowledge on the following topics
2. To introduce the smart system technologies and its role in real time applications
3. To teach the architecture and requirements of Home Automation
4. To provide an insight into smart appliances and energy management concepts
5. To familiarize the design and needs of smart wearable devices and basics of robotics and its role for automation

UNIT-I: INTRODUCTION**9**

Overview of a smart system - Hardware and software selection - Smart sensors and Actuators – Communication protocols used for smart systems

UNIT-II: HOME AUTOMATION**9**

Home Automation – System Architecture - Essential Components- Design Considerations: Control Unit, Sensing Requirements, Communication, Data Security.

UNIT-III: SMART APPLIANCES AND ENERGY MANAGEMENT**9**

Significance of smart appliances for energy management -Smart Meters: Significance, Architecture & Energy Measurement Technique – Security Considerations.

UNIT-IV: SMART WEARABLE DEVICES**9**

Body Area Networks - Sensors– communication protocol for Wearable devices- Application of Smart Wearable in Healthcare & Activity Monitoring.

UNIT-V: EMBEDDED SYSTEMS AND ROBOTICS**9**

Robot definition- Fundamental concepts in Robotics- Robots and Controllers components - Embedded processor based: pick and place robot- Mobile Robot Design- UAV.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1. Explain the fundamental concepts of smart system design and identify recent technological developments.
- CO2. Demonstrate the use of embedded open-source and cost-effective tools for

developing solutions in real-time applications.

C03. Compare and analyze various platforms and infrastructures used for smart system implementation.

C04. Illustrate the operation of smart appliances and evaluate energy management techniques.

C05. Apply knowledge of embedded systems to enhance employability and develop entrepreneurial solutions.

TEXT BOOKS:

T1. Dipankar Saha, "Smart Home Automation with IoT: The Ultimate DIY Guide for Making Smart Homes Using Open-Source Softwares", BPB Publications, 1st Edition, 2024.

T2. Raj Kamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill Education, 4th Edition, 2020.

REFERENCES:

R1. Nilanjan Dey, Amartya Mukherjee, "Embedded Systems and Robotics with Open-Source Tools", CRC Press, 1st Edition, 2018.

R2. Antonio Moreno-Munoz, "Energy Smart Appliances: Applications, Methodologies, and Challenges", Wiley, 1st Edition, 2023.

R3. Thomas Bräunl, "Embedded Robotics: From Mobile Robots to Autonomous Vehicles with Raspberry Pi and Arduino", Springer, 4th Edition, 2022.

R4. Woon-Hong Yeo, Yun Soung Kim, "Smart and Connected Wearable Electronics: Nanomanufacturing, Soft Packaging, and Healthcare Devices", Woodhead Publishing, 1st Edition, 2024

R5. K. Gopal Ram, D. K. Kalaivani, I. P. Rakhesh, M. Sivaprakash, "Wearable Devices", San International Scientific Publication, 1st Edition, 2025.

COURSE ARTICULATION MATRIX:

PEE305	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	1	3	1	3								1	2	2	
CO2	3	1	2	2	3								1	1	3	
CO3	2	2	3	2	3								2	2	2	
CO4	2	2	2	1	3								1	2	2	
CO5	3	2	2	2	3				1				2	2	3	
Average	2.4	1.6	2.4	1.6	3.0				1				1.4	1.8	2.4	

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To expose the students to the fundamentals and building of Electronic Engine Control systems.
2. To teach on sensor functional components for vehicles.
3. To discuss on programmable controllers for vehicles management systems.
4. To teach logics of automation & communication techniques for vehicle communication.
5. To introduce the infotainment system development.

UNIT-I: INTRODUCTION TO AUTOMOTIVE SYSTEMS**9**

Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Electronic control Unit– open-source ECU.

UNIT -II: SENSORS AND ACTUATORS FOR AUTOMOTIVES**9**

Review of automotive sensors- sensors interface to the ECU, Smart sensor and actuators for automotive applications.

UNIT -III: VEHICLE MANAGEMENT SYSTEMS**9**

Energy Management system -Adaptive cruise control - anti-locking braking system Safety and Collision Avoidance.

UNIT -IV: ONBOARD DIAGNOSTICS AND COMMUNICATION**9**

OBD, Vehicle communication protocols- Bluetooth, CAN, LIN, FLEXRAY and MOST.

UNIT -V: RECENT TRENDS**9**

Navigation- Autonomous car- Role of IoT in Automotive systems.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

- CO1. Insight into the significance of the role of embedded system for automotive applications.
- CO2. Assess the need, selection of sensors and actuators and interfacing with ECU
- CO3. Develop the Embedded concepts for vehicle management and control systems.
- CO4. Demonstrate the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs
- CO5. Improved Employability and entrepreneurship capacity due to knowledge up

gradation on recent trends in embedded systems design and its application in automotive systems.

TEXT BOOKS:

- T1. William B. Ribbens," Understanding Automotive Electronics", Elsevier, 8th Edition, 2017.
- T2. L.Vlacic, M.Parent, F.Harahima,"Intelligent Vehicle Technologies", SAE International, 2001, 1st Edition, 2017.
- T3. Jurgen, R., Automotive Electronics Hand Book, McGraw Hill, 2nd Edition, 1999.

REFERENCES:

- R1. Ali Emedi, Mehrdedehsani, John M Miller , "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2003, 1st Edition.
- R2. Jack Erjavec, JeffArias," Alternate Fuel Technology-Electric, Hybrid& Fuel Cell Vehicles", Cengage ,2023, 3rd Edition.
- R3. Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection –Ford 2nd Edition, 2004.
- R4. Automotive Electricals / Electronics System and Components, Tom Denton, 5th Edition, 2017.
- R5. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1st Edition, 2005.

COURSE ARTICULATION MATRIX :

PEE306	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	3	2	2	1								2	1	3	1
CO2	2	3	3	2	2								2	2	2	2
CO3	3	3	3	3	3								2	1	3	1
CO4	3	3	3	3	3								1	3	2	3
CO5	3	3	1	2	1				1				2	2	3	2
Average	2.4	3	2.4	2.4	2				1				1.8	1.8	2.6	1.8

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To learn the structure of Electric Vehicle, Hybrid Electric Vehicle
2. To study about the EV conversion components
3. To know about the details and specifications for Electric Vehicles
4. To understand the concepts of Plug-in Hybrid Electric Vehicle
5. To model and simulate all types of DC motors

UNIT-I: VEHICLE ARCHITECTURE and SIZING 9

Electric Vehicle History, Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Types of EVs-Micro and Mild architectures. Mountain Bike – Motorcycle - Electric Cars and Heavy Duty EVs. -Details and Specifications.

UNIT-II: VEHICLE MECHANICS 9

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire –Road mechanics, Propulsion System Design.

UNIT-III: POWER COMPONENTS AND BRAKES 9

Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Powertrain sizing, Example.

UNIT-IV: HYBRID VEHICLE CONTROL STRATEGY 9

Vehicle supervisory control, Mode selection strategy, Modal Control strategies.

UNIT-V: PLUG-IN HYBRID ELECTRIC VEHICLE 9

Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging mechanisms-Advantages of PHEVs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Summarize the history and evolution of Electric Vehicles (EVs), including Hybrid and Plug-In Hybrid Electric Vehicles (PHEVs).

- CO2. Describe the structure and function of various components used in electric vehicles.
- CO3. Explain the key concepts and technologies associated with Plug-In Hybrid Electric Vehicles.
- CO4. Analyze the technical specifications and performance characteristics of different EV models.
- CO5. Describe the control strategies employed in hybrid electric vehicle systems.

TEXT BOOKS:

- T1. Per Enge, "Electric Vehicle Engineering", McGraw Hill, 1st Edition, 2023.
- T2. Krishan Arora, "Electric Vehicle Design: Design, Simulation, and Applications", Wiley, 1st Edition, 2023.

REFERENCES:

- R1. Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 3rd Edition, 2022.

COURSE ARTICULATION MATRIX:

PEE401	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		2					1				2	3			
CO2	3		2					1				2	3	3	3	
CO3	3		2					1				2	3			
CO4	3		2					1				2	3			
CO5	3		3	3	3			1				2	3	3	3	
Average	3.0		2.2	3.0	3.0			1.0				2.0	3.0	3.0	3.0	

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To review the drive cycles and requirements of EVs
2. To know the working of motors used in Electric Vehicle
3. To analyze and model the buck/boost converter operation and to design the same
4. To learn the simulation basics of control systems
5. To derive transfer functions for DC-DC converters

UNIT-I: ELECTRIC VEHICLE DYNAMICS**9**

Standard drive cycles-Dynamics of Electric Vehicles-Tractive Force-Maximum speed, torque, power, energy requirements of EVs,

UNIT-II: MOTORS FOR ELECTRIC VEHICLES**9**

Introduction – Speed and Torque control of above and below rated speed-Speed control of EV in the constant power region of electric motors. DC Motors, Induction Motor, Permanent Magnet Synchronous Motors (PMSM), Brushless DC Motors, Switched Reluctance Motors (SRMs). Synchronous Reluctance Machines-Choice of electric machines for EVs.

UNIT-III: BASICS OF SIMULATION IN CONTROL SYSTEMS**9**

Transfer Function-How to build transfer function, identify Poles, zeros, draw time response plots, bode plot (Bode Plots for Multiplication Factors, Constant, Single and Double Integration Functions, Single and Double Differentiation Functions, Single Pole and Single Zero Functions, RHP Pole and RHP Zero Functions), state space modelling-transfer function from state space Model

UNIT-IV: MODELING OF DC-DC CONVERTERS**9**

Overview of PWM Converter Modelling -Power Stage Modelling - PWM Block Modelling - Voltage Feedback Circuit and Small-Signal Model of PWM Converter - Averaging Power Stage Dynamics - Average Models for buck/boost Converter - Small-Signal Model of Converter Power Stage - Frequency Response of Converter- Inverter Type (ZVC & ZCS), Single Phase ARS Inverter Topology, Speed Control of Induction Motor, FOC, Adaptive Control, Model Reference Adaptive Control (MARS), Sliding mode Control.

UNIT-V: POWER STAGE TRANSFER FUNCTIONS OF DC – DC CONVERTERS**9**

Power Stage Transfer Functions of buck-boost Converter in CCM Operation, Input-to-Output Transfer Function, Duty Ratio-to-Output Transfer Function, Load Current-to-Output Transfer Function

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1. Select and justify the appropriate type of electric machine for various electric vehicle applications based on performance and system requirements.
- CO2. Compute the transfer function of systems involving constant, integral, differential, first-order, and second-order factors in both numerators and denominators.
- CO3. Derive transfer functions from state-space models of dynamic systems.
- CO4. Design buck, boost, and buck-boost converters for specified voltage and current requirements.
- CO5. Compute the power stage transfer functions of DC-DC converters, simulate their operation, and analyze their gain margin and phase margin using frequency response methods.

TEXT BOOKS:

- T1. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, First Edition 2017.
- T2. Fundamentals of Power Electronics with MATLAB, Randall Shaffer, 2nd Edition, 2013, Lakshmi publications.

REFERENCES:

- R1. Feedback Control problems using MATLAB and the Control system tool box, Dean Frederick and Joe Cho, 2000, 1st Edition, Cengage learning.
- R2. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005, 1st Edition.
- R3. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley, 2021, 1st Edition .
- R4. Emerging Power Converters for Renewable Energy and Electric Vehicles Modeling, Design and Control, Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd. Hasan Ali, CRC Press, 2021, 1st Edition.

- R5. Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals, Second Edition”
CRC Press, Taylor & Francis Group, Third Edition 2021.

COURSE ARTICULATION MATRIX:

PEE402	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	-	-	-	-	-	-	-	3	-	1	1	-
CO2	3	3	3	3	-	-	-	-	-	-	-	3	-	1	1	-
CO3	3	3	3	3	-	-	-	-	-	-	-	3	-	1	1	-
CO4	3	3	3	3	-	-	-	-	-	-	-	3	-	1	1	-
CO5	3	3	3	3	-	-	-	-	-	-	-	3	-	1	1	-
Average	3	3	3	3	-	-	-	-	-	-	-	3	-	1	1	-

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To learn the basics of EV and vehicle mechanics
2. To know the EV architecture
3. To study the energy storage system concepts
4. To derive model for batteries and to know the different types of batteries and its charging methods
5. To learn the control preliminaries for DC-DC converters.

UNIT-I: INTERNAL COMBUSTION ENGINES 9

IC Engines, BMEP and BSFC, Vehicle Fuel Economy, Emission Control Systems, Treatment of Diesel Exhaust Emissions.

UNIT-II: ELECTRIC VEHICLES AND VEHICLE MECHANICS 9

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings- Comparisons of EV with internal combustion Engine vehicles- Fundamentals of vehicle mechanics-Introduction to smart grid Technologies.

UNIT-III: BATTERY MODELING, TYPES AND CHARGING 9

Batteries in Electric and Hybrid Vehicles - Battery Basics -Battery Parameters. Types- Lead Acid Battery - Nickel-Cadmium Battery - Nickel-Metal-Hydride (NiMH) Battery - Li-Ion Battery - Li-Polymer Battery, Zinc-Air Battery, Sodium-Sulphur Battery, Sodium-Metal-Chloride, Research and Development for Advanced Batteries. Battery Modeling, Electric Circuit Models. Battery Pack Management, Battery Charging.

UNIT-IV: CONTROL PRELIMINARIES 9

Control Design Preliminaries - Introduction - Transfer Functions – Bode plot analysis for First order and second order systems - Stability - Transient Performance- Power transfer function for boost converter - Gain margin and Phase margin study-open loop mode

UNIT-V: CONTROL OF AC MACHINES 9

Introduction- Reference frame theory, basics-modeling of induction and synchronous machine in various frames-Vector control- Direct torque control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Describe the concepts related with EV, HEV and to compare the same with internal combustion engine vehicles
- CO2. Find gain margin & phase margin for various types of transfer functions of boost converter Analyze the operation of the n-pulse converters and evaluate the performance parameters
- CO3. Demonstrate the Control of A C Machine.
- CO4. Explain the concepts related with batteries and parameters of battery
- CO5. Module the battery and to study the research and development for batteries

TEXT BOOKS:

- T1. Electric and Hybrid Vehicles, Design Fundamentals, Third Edition, Iqbal Husain, CRC Press, 2021.
- T2. Power Electronic Converters, Dynamics and Control in Conventional and Renewable Energy Applications, Teuvo Suntio, Tuomas Messo, Joonas Puukko, 1st Edition, Wiley - VCH.

REFERENCES:

- R1. Ali Emadi, Mehrdad Ehsani, John M. Miller, "Vehicular Electric Power Systems", Special Indian Edition, Marcel Dekker, Inc 2003, 1st Edition.
- R2. C.C. Chan and K.T. Chau, 'Modern Electric Vehicle Technology', OXFORD University Press, 2001, 1st Edition.
- R3. Wie Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, John Wiley & Sons, 2017, 2nd Edition.
- R4. Dynamic Simulation of Electric Machinery using MATLAB, Chee Mun Ong, Prentice Hall, 1997, 1st Edition.
- R5. Electrical Machine Fundamentals with Numerical Simulation using MATLAB/SIMULINK, Atif Iqbal, Shaikh Moinoddin, Bhimireddy Prathap Reddy, Wiley, 2021, 1st Edition

COURSE ARTICULATION MATRIX:

PEE403	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	-	-	-	-	1	-	-	2	-	2	-	1	1	-
CO2	3	3	-	-	-	-	1	-	-	2	-	2	-	1	1	-
CO3	3	3	-	-	-	-	1	-	-	2	-	3	-	1	1	-
CO4	3	3	-	-	-	-	1	-	-	2	-	3	-	1	1	-
CO5	3	3	-	-	-	-	1	-	-	2	-	3	-	1	1	-
Average	3	3	-	-	-	-	1	-	-	2	-	2.6	-	1	1	-

COURSE OBJECTIVES:

1. To know the charging station and standards
2. To learn the concepts of power converters in charging
3. To find the charging scheme in renewable based EV charging
4. To demonstrate the wireless power transfer technique
5. To design & simulate power factor correction circuits

UNIT-I: CHARGING STATIONS AND STANDARDS 9

Introduction-Charging technologies- Conductive charging, EV charging infrastructure, International standards and regulations - Inductive charging, need for inductive charging of EV, Modes and operating principle, Static and dynamic charging, Bidirectional power flow, International standards and regulations.

UNIT-II: POWER ELECTRONICS FOR EV CHARGING 9

Layouts of EV Battery Charging Systems-AC charging-DC charging systems- Power Electronic Converters for EV Battery Charging- AC–DC converter with boost PFC circuit, with bridge and without bridge circuit - Bidirectional DC–DC Converters- Non-isolated DC–DC bidirectional converter topologies- Half-bridge bidirectional converter.

UNIT-III: EV CHARGING USING RENEWABLE AND STORAGE SYSTEMS 9

Introduction- - EV charger topologies , EV charging/discharging strategies - Integration of EV charging-home solar PV system , Operation modes of EVC-HSP system , Control strategy of EVCHSP system - fast-charging infrastructure with solar PV and energy storage.

UNIT-IV: WIRELESS POWER TRANSFER 9

Introduction - Inductive, Magnetic Resonance, Capacitive types. Wireless Chargers for Electric Vehicles - Types of Electric Vehicles - Battery Technology in EVs -Charging Modes in EVs - Benefits of WPT. - WPT Operation Modes - Standards for EV Wireless Chargers, SAE J2954, IEC 61980. ISO 19363.

UNIT-V: POWER FACTOR CORRECTION IN CHARGING SYSTEM 9

Need for power factor correction- Boost Converter for Power Factor Correction, Sizing the Boost Inductor, Average Currents in the Rectifier and calculation of power losses.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Illustrate various electric vehicle charging techniques and interpret relevant charging standards and regulations.
- CO2. Demonstrate the working principles of DC-DC converters used in EV charging systems.
- CO3. Explain the benefits and applications of renewable energy-based EV charging systems.
- CO4. Demonstrate the principles of wireless power transfer and analyze applicable standards for wireless charging.
- CO5. Design and simulate a boost converter for power factor correction in EV charging applications.

TEXT BOOKS:

- T1. Mauro Feliziani, "Wireless Power Transfer for E-Mobility: Fundamentals and Design Guidelines for Wireless Charging of Electric Vehicles", Elsevier, 2023.

REFERENCES:

- R1. Dharavath Kishan, Kannan Ramani, Dastagiri Reddy, Prajof Prabhakaran, "Power Electronics for Electric Vehicles and Energy Storage: Emerging Technologies and Developments", CRC Press, 2023.
- R2. IEC 61851-23 Ed. 2.0, "Electric Vehicle Conductive Charging Systems – Part 23: DC Electric Vehicle Charging Station", International Electrotechnical Commission, 2023.

COURSE ARTICULATION MATRIX:

PEE404	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3			2	2		3		3	3			
CO2	3	3	3	3			2	2		3		3	3	3	3	
CO3	3												3	3	3	
CO4	3	3	3	3			2	2		2		1	3	3	3	
CO5	3												3	3	3	
Average	3.0	3.0	3.0	3.0			2.0	2.0		2.7		2.3	3.0	3.0	3.0	

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To know various standardization procedures.
2. To learn the testing procedures for EV & HEV components.
3. To know the functional safety and EMC.
4. To realize the effect of EMC in EVs.
5. To study the effect of EMI in motor drives and in DC-DC converter system.

UNIT-I: EV STANDARDIZATION**9**

Introduction - Current status of standardization of electric vehicles, electric Vehicles and Standardization - Standardization Bodies Active in the Field – Standardization activities in countries like Japan. The International Electro Technical Commission - Standardization of Vehicle Components.

UNIT -II: TESTING OF ELECTRIC MOTORS AND CONTROLLERS FOR ELECTRIC AND HYBRID ELECTRIC VEHICLES**9**

Test Procedure Using M-G Set, electric motor, controller, application of Test Procedure, Analysis of Test Items for the Type Test - Motor Test and Controller Test (Controller Only). - Test Procedure Using Eddy Current Type Engine Dynamometer, Test Strategy, Test Procedure, Discussion on Test Procedure. Test Procedure Using AC Dynamometer- Hybrid Electric Vehicles Tests (M and N category).

UNIT -III: FUNDAMENTALS OF FUNCTIONAL SAFETY AND EMC**9**

Functional safety life cycle - Fault tree analysis - Hazard and risk assessment – software development - Process models - Development assessments - Configuration management – Reliability - Reliability block diagrams and redundancy - Functional safety and EMC - Functional safety and quality – Standards - Safety Norms, Energy consumption and Power test- Functional safety of autonomous vehicles.

UNIT -IV: EMC IN ELECTRIC VEHICLES**9**

Introduction - EMC Problems of EVs, EMC Problems of Motor Drive, EMC Problems of DC-DC Converter System, EMC Problems of Wireless Charging System, EMC Problem of Vehicle Controller, EMC Problems of Battery Management System, Vehicle EMC Requirements

UNIT -V: EMI IN MOTOR DRIVE AND DC-DC CONVERTER SYSTEM**9**

Overview -EMI Mechanism of Motor Drive System, Conducted Emission Test of Motor Drive System, IGBT EMI Source, EMI Coupling Path, EMI Modelling of Motor Drive System. EMI in DC-DC Converter, EMI Source, The Conducted Emission High-Frequency, Equivalent Circuit of DC-DC Converter System, EMI Coupling Path

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

CO1: To describe the status and other details of standardization of EVs.

CO2: To illustrate the testing protocols for EVs and HEV components.

CO3: To analyze the safety cycle and need for functions safety for EVs.

CO4: To analyze the problems related with EMC for EV components.

CO5: To evaluate the EMI in motor drive and DC-DC converter system.

TEXT BOOKS:

- T1. Handbook of Automotive Power Electronics and Motor Drives, Ali Emadi, Taylor & Francis, 2005, 1st Edition.
- T2. Electromagnetic Compatibility of Electric Vehicle, Li Zhai, Springer 2021, 1st Edition.
- T3. EMC and Functional Safety of Automotive Electronics, Kai Borgeest, IET 2018, 1st Edition.

REFERENCES:

- R1. EMI/EMC Computational Modeling Handbook, Druce Archam beault, colin branch, Omar M.Ramachi ,Springer 2012, 2nd Edition.
- R2. Automotive EMC, Mark Steffika, Springer-Verlag New York Inc.; 2004th edition (31 December 2003); CBS Publishers And Distributors Pvt. Ltd. , 204 F.I.E Patparganj Industrial Area New Delhi 110092.
- R3. Electric Vehicle Systems Architecture and Standardization Needs, Reports of the PPP European Green Vehicles Initiative, Beate Müller, Gereon Meyer, Springer 2016, 1st Edition.

COURSE ARTICULATION MATRIX:

PEE405	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3			2	2		3		3	3			
CO2	3	3	3	3			2	2		3		3	3	3	3	
CO3	3												3	3	3	
CO4	3	3	1	3			2	2		2		1	3	3	3	
CO5	3												3	3	3	
Average	3	3	2.3	3			2	2		2.7		2.3	3	3	3	

COURSE OBJECTIVES:

To impart knowledge on the following topics

6. To know the basic details of V2G.
7. To study the benefits of V2G.
8. To study the challenges of V2G.
9. To learn EV & V2G on the smart grids renewable energy systems.
10. To know the grid integration.

UNIT-I: DEFINITION AND STATUS OF V2G**9**

Defining Vehicle to Grid (V2G) - History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering, V2G in Practice, V2G - Power Markets and Applications. Electricity Markets and V2G Suitability, Long-Term Storage, Renewable Energy, and Other Grid Applications, Beyond the Grid: Other Concepts Related to V2G-G2V technology.

UNIT -II: BENEFITS AND CHALLENGES OF V2G**9**

Benefits of V2G, Technical Benefits: Storage Superiority and Grid Efficiency, Economic Benefits: EV Owners and Societal Savings, Environment and Health Benefits: Sustainability in Electricity and Transport, Other Benefits.

UNIT -III: CHALLENGES TO V2G**9**

Technical Challenges-Battery Degradation, Charger Efficiency, Charging infrastructure requirements for V2G, Aggregation and Communication, V2G in a Digital Society. The Economic and Business Challenges to V2G - Evaluating V2G Costs and Revenues, EV Costs and Benefits, Adding V2G Costs and Benefits, Additional V2G Costs, The Evolving Nature of V2G Costs and Benefits. Regulatory and Political Challenges to V2G, V2G and Regulatory Frameworks, Market Design Challenges. Other V2G Regulatory and Legal Challenges.

UNIT -IV: IMPACT OF EV AND V2G ON THE SMART GRID AND RENEWABLE ENERGY SYSTEMS**9**

Introduction - Types of Electric Vehicles - Motor Vehicle Ownership and EV Migration - Impact of Estimated EVs on Electrical Network - Impact on Drivers and the Smart Grid - Standardization and Plug-and-Play - IEC 61850 Communication Standard and IEC 61850-7-420 Extension-Impact of V2G on Various Renewable Energy Systems.

UNIT -V: GRID INTEGRATION AND MANAGEMENT OF EVS**9**

Introduction - Machine to Machine (M2M) in distributed energy management systems - M2M communication for EVs - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles -M2M communication with scheduling.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

- CO1. Explain the concepts related with V2G.
- CO2. Study the grid connection of 3 phase Q inverter.
- CO3. Explain the technical, economics. business, regulatory & political challenges related with V2G.
- CO4. Demonstrate the impact of EV and V2G on smart grid and renewable energy system
- CO5. Explain the concept of grid integration and management of EVs.

TEXT BOOKS:

- T1. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press 2017.
- T2. Plug In Electric Vehicles in Smart Grids, Charging Strategies, Sumedha Rajakaruna , Farhad Shahnian and Arindam Ghosh, Springer,2016.
- T3. ICT for Electric Vehicle Integration with the Smart Grid, Nand Kishor ; Jesus Fraile-Ardanuy, IET 2020.

REFERENCES:

- R1. Lance Noel Gerardo Zarazua de Rubens Johannes Kester · Benjamin K. Sovacool, Vehicle- to-Grid A Sociotechnical Transition Beyond Electric Mobility, 2019.
- R2. Vehicle-to-Grid: Linking Electric Vehicles to the Smart Grid, Junwei Lu and Jahangir Hossain, IET 2015.

COURSE ARTICULATION MATRIX:

PEE406	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3						2	1		2			3	2		
CO2	3	3			3		2	1		2			3	2		
CO3	3						2	1		2			3	2		
CO4	3						2	1		2			3	2		
CO5	3						2	1		2			3	2		
Average	3	3			3		2	1		2			3	2		

PEI201	PROCESS MODELLING AND SIMULATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop mathematical model and dynamic simulator for chemical processes.
- To expose the students to various chemical production processes.
- To develop various processes and unit operations using numerical methods.
- To use the process simulation as a tool for understanding a chemical process.
- This course deals with understanding physical systems in chemical engineering and to develop their mathematical models

UNIT-I INTRODUCTION TO PROCESS MODELING 9

Introduction to process modeling - a systematic approach to model building, classification of models, Conservation principles, thermodynamic principles of process systems.

UNIT-II MODELLING PRINCIPLES FOR LUMPED PARAMETER SYSTEMS 9

Development of steady state and dynamic lumped and distributed parameter models based on first principles. Analysis of ill-conditioned systems, Models with stiff differential equations.

UNIT-III DEVELOPMENT AND VALIDATION OF GREY-BOX MODELS 9

Development of grey box models, Empirical model building, Statistical model calibration and validation, Introduction to population balance models, multi-scale modeling.

UNIT-IV SOLUTION STRATEGIES FOR LUMPED PARAMETER MODELS AND STIFF DIFFERENTIAL EQUATIONS 9

Solution strategies for lumped parameter models and stiff differential equations, Solution methods for initial value and boundary value problems. Euler's method. R-K methods, shooting method, finite difference methods – predictor corrector methods.

UNIT-V METHODS OF SOLVING DISTRIBUTED PARAMETER MODELS 9

Solution strategies for distributed parameter models. Solving parabolic, elliptic and hyperbolic partial differential equations. Introduction to finite element and finite volume methods.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Develop process models based on conservation principles and process data.
2. Apply computational techniques to solve the process models
3. Apply different methods for parameters estimation
4. Develop model equations for a given system.
5. Simulate process models using MATLAB/SCILAB

TEXT BOOKS:

1. K. M. Hangos and I. T. Cameron, Process Modeling and Model Analysis, Academic Press, 2001.
2. W.L. Luyben, Process Modeling, Simulation and Control for Chemical Engineers, 2nd Edn., McGraw Hill Book Co., New York, 1990.
3. Singiresu S. Rao, Applied Numerical Methods for Engineers and Scientists Prentice Hall, Upper Saddle River, NJ, 2001.

REFERENCE BOOKS:

1. Bruce A. Finlayson, Introduction to Chemical Engineering Computing, Wiley, 2010.
2. W. F. Ramirez, Computational Methods for Process Simulation, 2nd ed., Butterworths, 1997.
3. Amiya K. Jana, Chemical Process Modelling and Computer Simulation, Prentice Hall of India, 2nd Edition, 2011.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2										2	3		
2	2	2		3	3							2		2	
3	2	3		3	2							2	2	2	
4	3	2	2	2									2	2	
5	2				3					2		2		3	2
Avg.	2.4	2.3	2.0	2.7	2.7					2.0		2.0	2.3	2.3	2.0

COURSE OBJECTIVES:

- To teach students to build and analyze models for time-varying systems and non-linear systems.
- To develop the skills needed to design adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller for various applications.
- To make the students learn to formulate optimal control schemes.
- To provide basic knowledge about Fractional-order systems and Fractional-order-controller and to lay the foundation for the systematic approach to Design controller for fractional order systems.
- To introduce FDI Techniques, such as Principal component Analysis, state observer to detect and diagnose faults in sensors and actuators.

UNIT-I REVIEW OF SYSTEMS 9

Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances. Transient response. Block diagrams.

UNIT-II STABILITY ANALYSIS 9

Stability Analysis: Frequency response, design of control system, process identification. PI Controller tuning - Ziegler-Nichols and Cohen-Coon tuning methods, Bode and Nyquist stability criterion. Process identification.

UNIT-III COMPLEX CONTROL TECHNIQUES 9

Advanced control techniques, cascade, ratio, feed forward, adaptive control, Smith predictor, internal model control, model based control systems- Case studies: Power plant.

UNIT-IV MULTIVARIABLE CONTROL ANALYSIS 9

Introduction to state-space methods, Control degrees of freedom analysis and analysis, Interaction, Bristol arrays, Niederlinski index - design of controllers, Tuning of multivariable PI controllers, Design of multivariable DMC and MPC.

UNIT-V SAMPLE DATA CONTROLLERS 9

Basic review of Z transforms, Response of discrete systems to various inputs. Open and closed loop response to step, impulse and sinusoidal inputs, closed loop response of discrete systems. Design of digital controllers.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Apply knowledge of mathematics, science, and engineering to build and analyze models for time-varying systems and non-linear systems.
2. Ability to design and implement adaptive controllers such as gain-scheduled adaptive controller, Model-reference adaptive controller and Self-tuning controller
3. Ability to Identify, formulate, and solve optimal controller
4. Ability to Analyze Fractional-order systems, Fractional-order- controller and Design controller for fractional order systems
5. Ability to design and implement H2 and H-infinity Controllers.

TEXT BOOKS:

1. D.R. Coughanour, S.E. LeBlanc, Process Systems analysis and Control, McGraw-Hill, 2nd Edition, 2009.
2. D.E. Seborg, T.F. Edgar, and D.A. Millichamp, Process Dynamics and Control, John Wiley and Sons, 2nd Edition, 2004.
3. B.A.Ogunnaike and W.H.Ray, Process Dynamics, Modelling and Control, Oxford Press, 1994.

REFERENCE BOOKS:

1. B.W. Bequette, Process Control: Modeling, Design and Simulation, PHI, 2006.
2. S. Bhanot, Process Control: Principles and Applications, Oxford University Press, 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
1	3	1	1	-	-	1	1	-	-	-	-	1	-	-	-
2	3	1	1	1	2	1	1	-	-	-		1	-	-	-
3	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-
4	3	2	2	1	1	1	1	-	-	-	-	1	-	-	-
5	2	1	1	1	1	1	1	-	-	-	-	1	-	-	-
Avg.	2.8	1.4	1.4	1	1.3	1	1	-	-	-	-	1	-	-	-

COURSE OBJECTIVES:

- To introduce the concept of MIMO system.
- To impart knowledge in Model Predictive Control.
- To impart knowledge in characteristics and performance of Model Predictive Control Scheme.
- To teach a variety of classical methods and techniques for analysis and design of Model Predictive Control.
- To develop practical control systems using Adaptive Model Predictive Control Scheme.

UNIT-I INTRODUCTION TO MIMO CONTROL 9

Introduction to MIMO Systems-Multivariable control-Multiloop Control-Multivariable IMC-IMCPID-Case studies.

UNIT-II MODEL PREDICTIVE CONTROL SCHEMES 9

Introduction to Model Predictive Control – Model Predictive Control Elements – Generalized Predictive Control Scheme - Multivariable Generalized Predictive Control Scheme - Multiple Model based Model Predictive Control Scheme Case Studies.

UNIT-III STATE SPACE BASED MODEL PREDICTIVE CONTROL SCHEME 9

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

UNIT-IV CONSTRAINED MODEL PREDICTIVE CONTROL SCHEME 9

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

UNIT-V ADAPTIVE CONTROL SCHEME 9

Introduction to Adaptive Control-Gain Scheduling-Self tuning regulators-MARS-Adaptive Model Predictive Control Scheme -Case Studies.

TOTAL : 45 PERIODS**COURSE OUTCOMES:**

1. Ability to apply engineering knowledge to understand the control schemes on MIMO

systems.

2. Ability to design controller for MIMO system.
3. Ability to analyze the control schemes available in industries.
4. Ability to design MPC, Adaptive controllers for practical engineering problems.
5. Ability to choose suitable controllers for the given problems.

TEXT BOOKS:

1. Coleman Brosilow, Babu Joseph, Techniques of Model-Based Control, Prentice Hall PTR Pub 2002, 1st Edition.
2. E. F. Camacho, C. Bordons, Model Predictive Control, Springer-Verlag London Limited 2007, 2nd Edition.
3. K.J. Astrom and B. J. Wittenmark, Adaptive Control, Second Edition, Pearson Education Inc., second Edition 2013.

REFERENCE BOOKS:

1. Paul Serban Agachi, Zoltan K. Nagy, Mircea Vasile Cristea, and Arpad Imre-Lucaci, Model Based Control Case Studies in Process Engineering, WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim 2007. 1st Edition.
2. Ridong Zhang, Anke Xue Furong Gao, Model Predictive Control Approaches Based on the Extended State Space Model and Extended Non-minimal State Space Model, Springer Nature Singapore Pte Ltd. 2019, 1st Edition.
3. J.A. ROSSITER, Model-Based Predictive Control A Practical Approach, Taylor & Francis eLibrary, 2005, 1st edition.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	3	2	-	1	3	-	-	-	-	2	-	1	-
2	3	1	2	1	-	-	-	-	-	-	-	-	-	-	-
3	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-
4	3	2	1	-	-	-	-	-	-	-	-	-	-	-	-
5	2	2	3	2	1	-	1	-	-	-	-	2	-	1	-
Avg.	2.8	1.8	2.2	1.5	1	1	2	-	-	-	-	2	-	1	-

on stability theory.

UNIT-V MODEL REFERENCE ADAPTIVE SYSTEM

9

Direct MRAS for general linear systems. Prior knowledge in MRAS. MRAS for partially known systems. Use of robust estimation methods in MRAS. The basic idea. Indirect self- tuning regulators. Direct Self-tuning regulators. Linear Quadratic STR. Adaptive Predictive control. Prior knowledge in STR.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Understand and explain about different model structures, parameterization, identifiability, structure determination and order estimation
2. Understand and explain about different model structures, parameterization, identifiability, structure determination and order estimation for nonlinear model
3. Understand and explain about different model structures, parameterization, identifiability, structure determination and order estimation for discrete model
4. Understand the effect of parameter variation and principle of adaptive control schemes
5. Understand the effect of parameter variation and principle of model reference adaptive system

TEXT BOOKS:

1. Torsten Soderstrom, Petre Stoica, System Identification, Prentice Hall International (UK) Ltd. 1989.
2. Karl J. Astrom & Bjorn Wittenmark, 'Adaptive Control', Pearson Education (Singapore), Second Edition, 2003.

REFERENCE BOOKS:

1. Arun K. Tangirala, Principles of System Identification: Theory and Practice, First Edition, CRC Press, 2014
2. Karel J. Keesman, System Identification: An Introduction, Springer-Verlag London, 2011
3. K.J. Astrom and B. Wittenmark, Adaptive Control, Second Edition, Dovers Publication.
4. L. Ljung, System Identification Theory for the User, Prentice-Hall, 2007

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	-	-	-	-	-	-	-	-	1	3	1	3
2	3	3	2	2	-	-	-	-	-	-	-	1	3	3	3
3	3	3	2	2	-	-	-	-	-	-	-	1	2	2	3
4	3	3	2	2	-	-	-	-	-	-	-	1	2	2	3
5	3	3	2	2	-	-	2	-	-	-	-	1	2	2	2
Avg.	3	3	2.2	2	-	-	2	-	-	-	-	1	2.4	2	2.8

COURSE OBJECTIVES:

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT-I STATE VARIABLE DESIGN 9

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control.

UNIT-II PHASE PLANE ANALYSIS 9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits - Singular points - Limit cycles - Construction of phase portraits - Phase plane analysis of linear and non-linear systems - Isocline method.

UNIT-III DESCRIBING FUNCTION ANALYSIS 9

Basic concepts, derivation of describing functions for common non-linearities - Describing function analysis of non-linear systems - limit cycles - Stability of oscillations.

UNIT-IV OPTIMAL CONTROL 9

Introduction - Time varying optimal control - LQR steady state optimal control - Solution of Ricatti's equation - Application examples.

UNIT-V OPTIMAL ESTIMATION 9

Optimal estimation - KalmanBucy Filter-Solution by duality principle-Discrete systems- Kalman Filter-Application examples.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Able to apply the knowledge gained on state feedback control and nonlinear control.
2. Ability to carryout analysis for common nonlinearities in a system.
3. Apply advanced control theory to practical engineering problems.

4. Design optimal controller.
5. Understand the basics and Importance of Kalman filter.

TEXT BOOKS:

1. G. J. Thaler, "Automatic Control Systems", Jaico Publishing House 1993.
2. M.Gopal, Modern Control System Theory, New Age International Publishers, 2002, 2nd Edition.
3. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006, 1st Edition.

REFERENCE BOOKS:

1. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002, 1st Edition.
2. K. Ogata, 'Modern Control Engineering', 5th Edition, PHI, New Delhi, 2009.
3. T. Glad and L. Ljung,, "Control Theory -Multivariable and Non-Linear Methods", Taylor & Francis, 2002, 1st Edition.
4. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009, 1st Edition.
5. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Tayler and Francies Group, 2011, 2nd Edition.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	2	2	2	1	1	1	3	1	3	1	1	2	2	2
2	3	3	3	2	1	1	1	3	1	3	1	1	2	2	2
3	3	2	2	2	1	1	1	3	1	3	1	1	2	2	2
4	3	3	3	3	1	1	1	3	1	3	1	1	2	2	2
5	2	1	2	1	1	1	1	2	1	2	1	1	2	2	2
Avg.	2.8	2.2	2.4	2.0	1.0	1.0	1.0	2.8	1.0	2.8	1.0	1.0	2.0	2.0	2.0

COURSE OBJECTIVES:

- To provide an exposure to different type of optimal control problems such as time- optimal, fuel optimal, energy optimal control problems.
- To impart knowledge and skills needed to design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems).
- To introduce concepts needed to design optimal controller using Dynamic Programming Approach and H-J-B equation.
- To provide an exposure to various types of fault tolerant control schemes such as Passive and active approaches.
- To introduce concepts needed to design optimal controller in the presence of state constraints and time optimal controller.

UNIT-I
CALCULUS OF VARIATIONS AND OPTIMAL CONTROL
9

Introduction - Performance Index- Constraints - Formal statement of optimal control system- Calculus of variations - Function, Functional, Increment, Differential and variation and optimum of function and functional - The basic variation problem Extrema of functions and functional with conditions - variational approach to optimal control system

UNIT-II
LINEAR QUADRATIC OPTIMAL CONTROL SYSTEM
9

Problem formulation - Finite time Linear Quadratic regulator - Infinite time LQR system: Time Varying case- Time-invariant case - Stability issues of Time-invariant regulator - Linear Quadratic Tracking system: Finite time case and Infinite time case.

UNIT-III
DISCRETE TIME OPTIMAL CONTROL SYSTEMS
9

Variational calculus for Discrete time systems - Discrete time optimal control systems:- Fixed final state and open-loop optimal control and Free-final state and open-loop optimal control - Discrete time linear state regulator system – Steady state regulator system.

UNIT-IV
OPTIMAL CONTROL
9

Pontryagin Minimum Principle - Dynamic Programming:- Principle of optimality, optimal control using Dynamic Programming - Optimal Control of Continuous time and Discrete-time systems - Hamilton-Jacobi-Bellman Equation - LQR system using H-J-B equation.

Time optimal control systems - Fuel Optimal Control Systems- Energy Optimal Control Systems
- Optimal Control Systems with State Constraints.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

1. Explain different type of optimal control problems such as time-optimal, fuel optimal, energy optimal control problems.
2. Design Linear Quadratic Regulator for Time-invariant and Time-varying Linear system (Continuous time and Discrete-time systems)
3. Design optimal controller using Dynamic Programming Approach and H-J-B equation.
4. Explain the Pontryagin Minimum Principle.
5. Design optimal controller in the presence of state constraints and time optimal controller.

TEXT BOOKS:

1. Donald E. Kirk, Optimal Control Theory – An Introduction, Dover Publications, Inc. Mineola, New York, 2012, 10th Edition.

REFERENCE BOOKS:

1. D. Subbaram Naidu, Optimal Control Systems, CRC Press, New York, 2003, 1st Edition.
2. Frank L. Lewis, Draguna Vrabie, Vassilis L. Syrmos, Optimal Control, 3rd Edition, Wiley Publication, 2012, 3rd Edition.
3. Yan Wang, Cheng-Lin Liu, Zhi-Cheng Ji, Quantitative Analysis and Optimal Control of Energy Efficiency in Discrete Manufacturing System, Springer, 2020, 1st Edition.

CO - PO and CO - PSO MAPPING:

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	3	3	3	3	-	1	1	-	-	-	-	-	2	2	2
2	2	2	1	1	-	1	1	-	-	-	-	-	2	2	2
3	3	2	2	2	-	1	1	-	-	-	-	-	2	2	2
4	3	3	3	2	-	1	1	-	-	-	-	-	2	2	2
5	3	3	3	3	-	1	1	-	-	-	-	-	2	2	2
Avg.	2.8	2.6	2.4	2.2	-	1	1	-	-	-	-	-	2	2	2

COURSE OBJECTIVES:

1. To understand the various types of energy storage Technologies.
2. To analyze thermal storage system.
3. To analyze different battery storage technologies.
4. To analyze the thermodynamics of Fuel Cell.
5. To study the various applications of energy storage systems.

UNIT-I: INTRODUCTION**9**

Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications.

UNIT -II: THERMAL STORAGE SYSTEM**9**

Thermal storage – Types – Modeling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of TRNSYS.

UNIT -III: ELECTRICAL ENERGY STORAGE**9**

Fundamental concept of batteries – measuring of battery performance, charging and discharging, power density, energy density, and safety issues. Types of batteries – Lead Acid, Nickel – Cadmium, Zinc Manganese dioxide, Li-ion batteries - Mathematical Modelling for Lead Acid Batteries – Flow Batteries.

UNIT -IV: FUEL CELL**9**

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantages and disadvantages.

UNIT -V: ALTERNATE ENERGY STORAGE TECHNOLOGIES**9**

Flywheel, Super capacitors, Principles & Methods – Applications, Compressed air Energy storage, Concept of Hybrid Storage – Applications, Pumped Hydro Storage – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Understand different types storage technologies.
- CO2. Design a thermal storage system.
- CO3. Analyze the thermodynamics of fuel cell.
- CO4. Analyze the appropriate storage technologies for different applications.
- CO5. Explore the alternate energy storage technologies.

TEXT BOOKS:

- T1. Ibrahim Dincer and Mark A. Rosen, 'Thermal Energy Storage Systems and Applications', John Wiley & Sons, 3rd Edition, 2021.
- T2. Ru-shi Liu, Lei Zhang and Xueliang sun, 'Electrochemical technologies for energy storage and conversion', Wiley publications, 2nd Volume set, 2012.

REFERENCES:

- R1. Lunardini.V.J, 'Heat Transfer in Cold Climates', John Wiley and Sons 1981, 1st Edition.
- R2. James Larminie and Andrew Dicks, 'Fuel cell systems Explained', Wiley publications, 3rd Edition, 2018.
- R3. Schmidt.F.W. and Willmott.A.J., 'Thermal Energy Storage and Regeneration', Hemisphere Publishing Corporation, 1981, 1st Edition.

COURSE ARTICULATION MATRIX:

PEE601	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		2										3			
CO2	3		2										3			
CO3	3		2										3			
CO4	3		2										3			
CO5	3		2										3			
Average	3		2										3			

COURSE OBJECTIVES:

1. To provide knowledge about different types of hybrid energy systems.
2. To analyze the various electrical Generators used for the Wind Energy Conversion Systems.
3. To design the power converters used in SPV Systems.
4. To analyze the various power converters used in hybrid energy systems and to understand the importance of standalone and grid-connected operation in Hybrid renewable energy systems.
5. To analyze the performance of the various hybrid energy systems.

UNIT-I: INTRODUCTION TO HYBRID ENERGY SYSTEMS**9**

Hybrid Energy Systems – Need for Hybrid Energy Systems – Solar-Wind-Fuel Cell-Diesel, Wind Biomass-Diesel, Micro-Hydel-PV, Ocean and geyser energy – Classification of Hybrid Energy systems – Importance of Hybrid Energy systems – Advantages and Disadvantages - Environmental aspects of renewable energy - Impacts of renewable energy generation on the environment - Present Indian and international energy scenario of conventional and RE sources - Ocean energy, Hydel Energy – Wind Energy, Biomass energy, Hydrogen energy - Solar Photovoltaic (PV) and Fuel cells: Operating principles and characteristics - Grid codes for Hybrid Energy Systems.

UNIT -II: ELECTRICAL MACHINES FOR WIND ENERGY CONVERSION SYSTEMS**9**

Review of reference theory fundamentals –Construction, Principle of operation and analysis: Squirrel Cage Induction Generator (SCIG), Doubly Fed Induction Generator (DFIG) - Permanent Magnet Synchronous Generator (PMSG).

UNIT -III: POWER CONVERTERS AND ANALYSIS OF SOLAR PV SYSTEMS**9**

Power Converters for SPV Systems - Line commutated converters (inversion-mode) - Boost and buck boost converters- selection of inverter, battery sizing, array sizing - Analysis of SPV Systems – Block diagram of the solar PV systems - Types of Solar PV systems: Stand-alone PV systems.

UNIT -IV: POWER CONVERTERS FOR HYBRID ENERGY SYSTEMS**9**

Introduction to Power Converters – Stand-alone Converters -AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters - Bi-Directional Converters - Grid-Interactive Inverters - Matrix converter – Merits and Limitations.

UNIT -V: HYBRID RENEWABLE ENERGY SYSTEMS

9

Hybrid Systems- Range and type of Hybrid systems – Performance Analysis – Cost Analysis – Case studies of Diesel-PV, Wind-PV-Fuel-cell, Micro-hydel-PV, Biomass-Diesel-Fuel-cell systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1: Analyze the impacts of hybrid energy technologies on the environment and demonstrate them to harness electrical power.
- CO2: Select a suitable Electrical machine for Wind Energy Conversion Systems and simulate wind energy conversion system.
- CO3: Design the power converters such as AC-DC, DC-DC, and AC-AC converters for SPV systems.
- CO4: Analyze the power converters such as AC-DC, DC-DC, and AC-AC converters for Hybrid energy systems.
- CO5: Interpret the hybrid renewable energy systems.

TEXT BOOKS:

- T1. Bahman Zohuri, “Hybrid Energy Systems”, Springer, First Edition, 2018.
- T2. S.M. Mueen, “Wind Energy Conversion Systems”, Springer First Edition, 2012.

REFERENCES:

- R1. Ernst Joshua, Wind Energy Technology, PHI, India, 2018, 3rd Edition.
- R2. Md. Rabiul Islam, Md. Rakibuzzaman Shah, Mohd Hasan Ali, "Emerging Power Converters for Renewable Energy and Electric Vehicles", CRC Press, First Edition, 2021.
- R3. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 7th Impression, 2005.
- R4. Rashid.M. H “Power electronics Hand book”, Academic press,4th Edition, 2018.
- R5. Rai. G.D, “Non-conventional energy sources”, Khanna publishers, 6th Edition, 2017.
- R6. Rai. G.D, “Solar energy utilization”, Khanna publishers, 3rd Edition, 1987.
- R7. Gray, L. Johnson, “Wind energy system”, Prentice Hall of India, 2nd Edition, 2006.
- R8. B.H.Khan "Non-conventional Energy sources", Tata McGraw hill Publishing Company, New Delhi, 2017, 3rd Edition.

COURSE ARTICULATION MATRIX:

PEE602	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	2										3			
CO2	3	3	2										3			
CO3	2	3	2										3		3	
CO4	3	3	2										3			
CO5	3	3	2										3			
Average	2.8	3	2										3		3	

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To review the renewable energy systems and technology
2. To learn the Single-phase grid-connected photovoltaic systems and three-phase photovoltaic systems
3. To learn the inverter for PV systems
4. To illustrate the small wind energy systems
5. To simulate the Doubly fed induction generator based WECS

UNIT-I: RENEWABLE ENERGY SYSTEMS: TECHNOLOGY OVERVIEW AND PERSPECTIVES 9

Introduction-State of the Art- Examples of Recent Research and Development Challenges and Future Trends.

UNIT-II: SINGLE-PHASE GRID-CONNECTED PHOTOVOLTAIC SYSTEMS 9

Introduction- Demands for Grid-Connected PV Systems-Power Converter Technology for Single-Phase PV Systems, Transformer less AC-Module Inverters (Module-Integrated PV Converters, Transformer less Single-Stage String Inverters, DC-Module Converters in Transformer less Double-Stage PV Systems

UNIT-III: THREE-PHASE PHOTOVOLTAIC SYSTEMS: STRUCTURES, TOPOLOGIES 9

Introduction-PV Inverter Structures, Three-Phase PV Inverter Topologies-Control Building Blocks for PV Inverters, Modulation Strategies for Three-Phase PV Inverters, Implementation of the Modulation Strategies., Grid Synchronization, Implementation of the PLLs for Grid Synchronization, Current Control, Implementation of the Current Controllers, Maximum Power Point Tracking.

UNIT-IV: BLDC MOTOR CONTROL 9

Introduction-Generator Selection for Small-Scale Wind Energy Systems- Turbine Selection for Wind Energy- Self-Excited Induction Generators for Small Wind Energy Applications- Permanent Magnet Synchronous Generators for Small Wind Power Applications- Grid-Tied Small Wind Turbine Systems-Magnus Turbine–Based Wind Energy System.

UNIT-V: SRM MOTOR CONTROL

9

Introduction – modelling of induction machine in machine variable form and arbitrary reference frame, modelling of Doubly-fed Induction Generator.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Review the perspectives of renewable energy systems
- CO2. Integrate photovoltaic systems with grid.
- CO3. Analyze inverter for PV systems.
- CO4. Create the working of small wind power systems
- CO5. Analyze the features of induction machine and doubly fed induction machine

TEXTBOOKS

- R1. Ahmad Azar, Nashwa Kamal, "Design, Analysis and Applications of Renewable Energy Systems", Academic Press, First Edition, 2021
- R2. Haoming Liu, Jingrui Zhang, Jian Wang (Eds.), "Modeling, Analysis and Control Processes of New Energy Power Systems", MDPI, First Edition, September 2024.

REFERENCE BOOKS

- R1. Power Conversion and Control of Wind Energy Systems, Bin Wu, Wiley-IEEE, 1st Edition, 2011.
- R2. Wind Electrical Systems, S.N. Bhadra, Oxford, 7th Impression, 2005.
- R3. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, IET, 2nd Edition, 2014.
- R4. Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS, Frede Blaabjerg, Dan M. Ionel, CRC press, 1st Edition, 2017.
- R5. Wu, Bin. Power Conversion and Control of Wind Energy Systems, 1st Edition, Wiley-IEEE, 2011.
- R6. Nabil Derbel, Quanmin Zhu "Modeling, Identification and Control Methods in Renewable Energy Systems", Springer, First Edition, 2019

Course Articulation Matrix

PEE603	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3		3	2												
CO2	3	2	3	3												
CO3	3	2	3	3	2											
CO4	3	2	3	3												
CO5	3	2	3	3	2											
Average	3.0	2.0	3.0	2.8	2.0											

COURSE OBJECTIVES:

1. To study about the present power Scenario
2. To model a micro grid system
3. To model power converter for grid interconnection
4. To integrate wind energy conversion system with grid
5. To simulate power converters like three phase inverters and DC-DC converters

UNIT-I: PRESENT POWER SCENARIO IN INDIA**9**

Introduction –Thermal Power Plant, Components of Thermal Power Plant, Major Thermal Power Plants in India- Gas-Based Power Generation - Nuclear Power Plants -Hydropower Generation -Pumped Storage Plants - Solar Power - Wind Energy – Power plants India-Various techniques of utilizing power from renewable energy sources.

UNIT-II: POWER GRIDS**9**

Introduction -Electric Power, Background, The Construction of a Power Grid System, Basic Concepts of Power Grids -Load Models - Modelling a Microgrid System - concept of nano/micro/mini grid.

UNIT-III: MODELING OF CONVERTERS IN POWER GRID DISTRIBUTED GENERATION SYSTEMS**9**

Introduction - Single-Phase DC/AC Inverters with Two Switches, Three-Phase DC/AC Inverters, Pulse Width Modulation Methods, The Triangular, The Identity Method, Analysis of DC/AC Three-Phase Inverters. Micro grid of Renewable Energy Systems- DC/DC Converters in Green Energy -Pulse Width Modulation -Sizing of an Inverter for Microgrid Operation, Sizing of a Rectifier for Microgrid Operation, The Sizing of DC/DC Converters for Micro grid.

UNIT-IV: WIND ENERGY SYSTEM GRID INTEGRATION**9**

Introduction- Significance of Electrical Power Quality in Wind Power System- Integration Issues in Grid-Connected Wind Energy- Effect of Power Quality Issues, Importance of Custom Power Devices- Power Quality Point of View

UNIT-V: GRID INTER CONNECTION**9**

Grid Code requirements -Grid integration of WECS-Grid Integration of PV systems- Ancillary

services in Indian Electricity Market (regulatory aspect) - CERC and CEA orders (technical and safety standards)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Review the power sector scenario in India.
- CO2. Model a microgrid system
- CO3. Model a converter for power grid distributed system.
- CO4. Integrate wind energy system.
- CO5. Simulate three phase inverters with fixed and sine PWM.

TEXT BOOKS:

- T1. Brian D’Andrade “The Power Grid”, Academic Press, 1st Edition, 2017.
- T2. Yang Han, "Modeling and Control of Power Electronic Converters for Microgrid Applications", Springer, 1st Edition 2022.
- T3. Siegfried Heier, "Grid Integration of Wind Energy: Onshore and Offshore Conversion Systems", John Wiley & Sons, Ltd, 2014, 3rd Edition.

REFERENCES:

- R1. Integration of Renewable Energy Sources with Smart Grid, M. Kathiresh, A. Mahaboob Subahani, and G.R. Kanaga chidambaresan, Scrivener & Wiley, 2021, 1st Edition.
- R2. Control and Operation of Grid-Connected Wind Energy Systems, Ali M. Eltamaly, Almoataz Y.Abdelaziz, Ahmed G. Abo-Khalil, Springer 2021, 1st Edition.
- R3. Design of smart power grid renewable energy systems, Third Edition, Ali Keyhani, Wiley 2019.
- R4. Power Electronic Converters, Teuvo Suntio, Tuomas Messo, Joonas Puukko, Wiley 2017, 1st Edition.
- R5. Fundamentals of Power Electronics with MATLAB, Randall Shaffer, Laxmi publications, 2013, 2nd Edition.
- R6. Power Conversion and Control of Wind Energy Systems, Bin Wu, 2011, Wiley-IEEE, 1st Edition.
- R7. Wind Power Integration - Connection and System Operational Aspects, Brendan Fox, 2014, IET, 2nd Edition.
- R8. Renewable Energy Devices and Systems with Simulations in MATLAB and ANSYS, Frede Blaabjerg, Dan M. Ionel, CRC press, 2017, 1st Edition.

COURSE ARTICULATION MATRIX:

PEE604	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3			-								3	3	3	3	
CO2	3		2	-	3							3	3	3	3	
CO3	3	3	3	2	3							3	3	3	3	
CO4	3	3	1	3	3							3	3	3	3	
CO5	3	3	2	3								3	3	3	3	
Average	3	3	2	2.7	3							3	3	3	3	

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To learn about the basic concepts of wind energy conversion system
2. To learn the design and control principles of Wind turbine
3. To understand the concepts of fixed speed wind energy conversion systems.
4. To understand the concepts of Variable speed wind energy conversion systems
5. To understand the grid integration issues.

UNIT-I: INTRODUCTION**9**

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin's Theory-Aerodynamics of Wind turbine

UNIT -II: WIND TURBINES**9**

HAWT-VAWT-Power Developed-Thrust-Efficiency-Rotor Selection-Rotor design considerations- Tip speed ratio-No. Of Blades-Blade profile-yaw control, Pitch angle control-stall control-Schemes for maximum power extraction

UNIT-III: FIXED SPEED SYSTEMS**9**

Generating Systems- Constant speed constant frequency systems –Choice of Generators Deciding Factors-Synchronous Generator-Squirrel Cage Induction Generator- Model of Wind Speed- Model wind turbine rotor – Generator model for Steady state and Transient stability analysis.

UNIT-IV: VARIABLE SPEED SYSTEMS**9**

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG- PMSG –Variable speed generators modeling – Variable speed variable frequency schemes

UNIT -V: GRID CONNECTED SYSTEMS**9**

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices, and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue

COURSE OUTCOMES:

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

- CO1. Attain knowledge on the basic concepts of Wind energy conversion system.
- CO2. Attain the knowledge of the mathematical modeling and control of the wind turbine.
- CO3. Develop more understanding on the design of Fixed speed system.
- CO4. Study about the need of Variable speed system and its modeling.
- CO5. Learn about Grid integration issues and current practices of wind interconnections with power system.

TEXT BOOKS:

- T1 L.L.Freris “Wind Energy conversion Systems”, Prentice Hall,1990.
- T2. S.N.Bhadra, D.Kastha,S.Banerjee, ”Wind Electrical Systems”, Oxford; Seventh Impression edition (29 July 2005)
- T3. Ion Boldea, “Variable speed generators”, CRC Press; 2nd edition (6 October 2015); CRC Press

REFERENCES:

- R1. E.W.Golding “The generation of Electricity by wind power”, Redwood burn Ltd. Trowbridge,1976
- R2. N. Jenkins,” Wind Energy Technology” John Wiley & Sons,1997
- R3. S.Heir “Grid Integration of WECS”, Wiley1998

COURSE ARTICULATION MATRIX:

PEE605	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	1	3	2	3	1					2	2	2		1	
CO2	3	1	3	2	3	1						1		1		
CO3	3	1	3	2	3	1	3					2	2	1		1
CO4	3	1	3	2	3	1					1	1				
CO5	3	1	3	2	3	1	2				3	1	1			
Average	2.6	1	3	2	3	1	2.5				2	1.4	1.7	1	1	1

COURSE OBJECTIVES:

To impart knowledge on the following topics

1. To impart knowledge on solar energy systems, wind energy systems and its applications.
2. To make students understand the fundamental theory governing solar thermal and photovoltaic devices
3. To understand the processes of generation of wind, its potential and energy extraction.
4. To know about different PV panel configurations and its characteristics
5. To understand use of solar energy for different applications like cooking, desalination, space heating etc.

UNIT-I: SOLAR ENERGY RADIATION AND SOLAR THERMAL COLLECTORS**9**

Solar energy - Introduction-Solar constant- Solar Radiation at the Earth's surface-measurements of solar radiation-pyrometer- pyrhelimeter- sunshine recorder- – Solar collectors - Flat plate collectors - collector efficiency - absorber plate – types - selective surfaces. Solar water heaters - types- their performance. Solar driers – types – heat transfer - performance of solar driers – agro industrial applications

UNIT -II: SOLAR CONCENTRATING COLLECTORS**9**

Concentrating collectors – types – reflectors - solar thermal power stations – principle and applications - Solar energy storage systems – thermal - sensible and latent heat, chemical, electrical, electro-magnetic energy storage – Solar distillation – application - Solar stills - types - Solar pond - performance – characteristics - applications – Solar refrigeration

UNIT-III: SOLAR PV TECHNOLOGY**9**

Solar photovoltaic technology –introduction – solar cell basics – Types of solar cells and modules – encapsulation – Design of solar PV system – load estimation - batteries – invertors – operation - system controls. Standalone and grid connected systems - PV powered water pumping - Hybrid system - Solar technologies in green buildings.

UNIT -IV: WIND ENERGY**9**

Nature of the wind – power in the wind – factors influencing wind – wind energy potential and installation in India- wind speed monitoring - wind resource assessment - wind power laws - velocity and power duration curves - Betz limit - site selection.

UNIT -V: TYPES OF WIND POWER AND ITS APPLICATIONS

9

Wind energy conversion devices - classification, characteristics, applications – Design of horizontal axis wind mill rotor diameter - Wind energy storage - wind farms – wheeling and banking - testing and certification procedures. Water pumping - Hybrid systems –Wind mill safety and environmental aspects

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- CO1. Gain insight into solar and wind energy resources
- CO2. Learn about the applications of solar and wind energy systems.
- CO3. Acquired skills on the choice of energy conversion technique for specific applications.
- CO4. Identify pros and cons of energy resources.
- CO5. Gain insight into the operation of wind farms and the economics of power generation.

TEXT BOOKS:

- T1. Rai., G.D., “Solar Energy Utilization”, Khanna publishers, New Delhi, 2025.
- T2. More, H.S and Maheshwari R.C., “Wind Energy Utilization in India”, CIAE Publication – Bhopal, 1982.
- T3. Solanki, C.S. “Renewable Energy Technologies: A Practical guide for beginners”, PHI learning Pvt. Ltd, New Delhi. 2008

REFERENCES:

- R1. Solanki, C.S., “Solar Photovoltaic Technology and Systems”, PHI learning Pvt. Ltd., New Delhi, 2013.
- R2. Rai. G.D., “Non-Conventional Sources of Energy”, Khanna Publishers, New Delhi, 2002
- R3. Rajput. R.K., “Non- Conventional Energy Sources and Utilization”, S. Chand & Company Pvt. Ltd, New Delhi, 2013

COURSE ARTICULATION MATRIX:

PEE606	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1		2			1					3	2				
CO2	1	1	2		2	3						1				
CO3	2	3	1	1		2	3					3				
CO4			1			2					1	2				
CO5	3	1	1	2			2				3	1				
Average	1.8	1.7	1.4	1.5	2	2	2.5				2.3	1.8				

OAG101	ENVIRONMENT AND AGRICULTURAL	L	T	P	C
	ENGINEERING	3	0	0	3

OBJECTIVES:

- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.
- To understand the ecological context of agriculture and its concerns.
- To study the context of climate change and emerging global issues.
- To introduce the students about the importance of the land and water resources in India.
- To study the importance of sustainable agriculture for the growing population, various resources required and their sustainability.

UNIT- I INTRODUCTION 9

Scope and importance of environmental studies. Natural resources: Renewable and renewable resources. Ecosystems: Definition, concept, structure and functions. Producers, consumers and decomposers of an ecosystem. Energy flow in the ecosystem. Types of ecosystems. Bio-diversity: Definition, classification, threats to biodiversity and its conservation.

UNIT- II ENVIRONMENTAL CONCERNS 9

Environmental pollution: Causes, effects and control of air, water, soil, thermal, noise and marine pollution. Disaster management. Floods, earthquakes, cyclones and landslides. Social issues and the environment, unsustainable to sustainable development. The Environment Protections Act, The Air Act, The water Act, The Wildlife Protection

UNIT- III CLIMATE CHANGE AND ECOLOGICAL DIVERSITY 9

Global warming and changing environment - Ecosystem changes - Changing blue green-grey water cycles – Water scarcity and water shortages – Desertification- Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insects and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.

UNIT- IV AGRICULTURAL IMPACTS 9

Irrigation development and watersheds - mechanized agriculture and soil cover

impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts – Agriculture versus urban impacts.

UNIT- V SUSTAINABLE AGRICULTURE

9

Sustainable agriculture-problems and its impact on agriculture, conservation agriculture strategies, HEIA, LELA and 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. N.P.Singh, Mhesh Kumar, N.V.Singh, Climate Resilient Agriculture for Sustainable Production, TTTP, 2023.
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. Gilbert M.Masters, ‘Introduction to Environmental Engineering and Science’, 3rd

edition, Pearson Education, 2023.

3. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.38 . Edition 2010.
4. Nem Raj Sunda"A Competitive Book of Agriculture (14th Edition)" Surahee Publications (2024)
5. M.H. Chavda, Y.B. Vala, C.K. Patel, P.P. Chaudhari, D.K. Patel "**Sustainable Agriculture: A Vision for Resilience Future**" KD Publications (2024).

OAG101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	-	-	-	1	1	-	-	1	-	-	-	-	-	-
CO2	2	3	1	-	2	3	-	-	1	-	1	1	-	-	-	-
CO3	1	3	-	-	-	1	2	-	-	-	-	2	-	-	-	-
CO4	3	3	3	2	3	-	3	2	1	-	2	3	-	-	-	-
CO5	-	3	2	2	3	-	3	3	-	-	2	3	-	-	-	-
Average	2.0	2.8	2.0	2.0	2.7	1.7	2.3	2.5	1.0	1.0	1.7	2.3	-	-	-	-

OAG102	ORGANIC FARMING FOR SUSTAINABLE	L	T	P	C
	AGRICULTURAL PRODUCTION	3	0	0	3

OBJECTIVES:

- To quantify the organic resources of integrated organic farming system (IOFS) components.
- To assess the total productivity of the system.
- To work out the economics of organic farming system.
- To gain knowledge on Organic Farming for Sustainable agriculture.
- To expose the students to the concept of Organic Farming.

UNIT - I INTRODUCTION TO ORGANIC FARMING 9

Concept of organic farming, Significance of organic farming for Indian farmers, Terminologies used in organic farming, Objectives of organic farming, Characteristics of organic farming, often debated issues in organic farming, Area under OF and size of organic food market. Status of organic farming in India.

UNIT - II SOIL HEALTH MANAGEMENT IN ORGANIC FARMING 9

Organic manures- Biofertilizers- Green manures- Crop rotation - Classification of Biofertilizers. Organic production requirements, Components. Nutrient requirements, Limiting nutrient losses, Farm Yard Manure (FYM), Enrichment of FYM.

UNIT - III MICROBIAL INOCULATIONS IN ORGANIC FARMING 9

Importance, benefits, Methods of vermicomposting, Preparation and management of vermicompost unit. Recycling of organic residues, Classification of organic residues Biofertilizers, Importance, classification and benefits of biofertilizers (Azospirillum, Azotobacter, Rhizibium, PSB, VAM etc.,)

UNIT - IV GOOD HARVESTING PRACTICES 9

Crop harvesting, signs of maturity in different field crops; physiological and crop Maturity- Methods of threshing crops, cleaning, drying and storage of field crops- Rainfed agriculture: Introduction, types, History of rainfed agriculture and watershed in India- Problems and prospects of rainfed agriculture in India.

UNIT - V ORGANIC REGULATION AND CERTIFICATION PROCEDURE, 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. S.P. Palaniappan & K. Annadurai "Organic Farming: Theory and Practice", Scientific Publishers (India) 2nd Edition (1 January 2022)
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. Rahul Kumar, Jitendra Kumar, Dr. Uma, Mahesh Kumar Singh and Monu Kumar "Manual on Organic Farming", Integrated Publications, 2021.
5. P.L.Maliwal "Principles Of Organic Farming" Scientific Publishers, 2022

REFERENCE BOOKS:

1. Khalid Rehman Hakeem, Gowhar Hamid Dar, Mohammad Aneesul Mehmood, Rouf Ahmad Bhat, "Microbiota and Biofertilizers A Sustainable Continuum for Plant and Soil Health", Springer, 2021.
2. S. Krishnaprabu, "Organic Farming and Farming Systems for Sustainable Agriculture", Satish Serial Publishing House, 2020
3. Latha, E, "Organic Farming for Sustainable Agriculture" Narendra Publishing House, 2022.
4. S.P. Palaniappan & K. Annadurai, "Organic Farming Theory and Practice" 2nd Edition, Scientific Publishers, 2022.

5. R. Sathya Priya, N. Jagathjothi, M. Yuvaraj, N. Suganthi Satish, “Organic Farming Principles & Practices”, Satish Serial Publishing House, 2024.

OAG102	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	3	2	-	-	2	-	1	-	-	-	-
CO2	1	3	-	2	-	2	2	2	-	-	-	3	-	-	-	-
CO3	3	-	-	2	-	-	3	-	-	2	-	1	-	-	-	-
CO4	3	2	-	-	3	2	-	-	-	-	-	3	-	-	-	-
CO5	-	-	-	2	-	-	3	3	-	-	2	-	-	-	-	-
Average	2.3	2.5		2.0	3.0	2.3	2.5	2.5		2.0	2.0	2.0	-	-	-	-

OAG103	SUSTAINABLE DEVELOPMENT THROUGH INDIAN KNOWLEDGE SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the structure and methods of ancient Indian education, focusing on holistic development through indigenous learning systems like Gurukuls, Pathshalas, and ancient universities.
- To explore how ancient Indian architecture, as seen in landmarks like the Ajanta Caves, Konark Sun Temple, and Brihadishvara Temple, embodies principles of sustainability and energy efficiency.
- To study traditional Indian farming techniques such as organic farming, rainfed Agriculture, and agroforestry to promote biodiversity and environmental stewardship.
- To understand the holistic approach of Ayurveda, focusing on the Interconnection of physical, mental, and spiritual health through individualized treatments based on one's Prakriti (constitution).
- To explore the moral responsibility humans have toward nature, focusing on the interconnectedness of life, environmental ethics, and wildlife conservation.

UNIT- I	ANCIENT EDUCATION SYSTEM IN INDIA	9

Indigenous education systems (Home, Temples, Pathshalas, Tols, Chatuspadis and Gurukuls)-methods- multi design learning Shastra, Kala, Vidya- Prominent Universities Nalaandha and Takshashila - Vocational Training and Focus on Ethics and Values - National Logic and Reasoning, Artistic Education, Astronomy and Mathematics.

UNIT- II VASTU SHASTRA AND SUSTAINABLE ARCHITECTURE 9

Historical Architecture Models (Ajanta Caves (Aurangabad) Brihadishvara Temple (Tanjore)Qutb Minar (Delhi)Konark Sun Temple (Odisha)Shore Temple (Mahabalipuram)-Vastu Shastra and Ancient Indian Architecture- Natural Forces (wind, water, sunlight, earth) - Energy Efficiency and Sustainable Materials - Eco-Friendly Construction- Communal Space and Architectural Carvings-Human Well-Being-Modern Integration of Vastu.

UNIT- III	SUSTAINABLE AGRICULTURE AND WATER MANAGEMENT IN INDIAN KNOWLEDGE SYSTEMS	9

Organic Farming and Rainfed Agriculture - Agroforestry and Biodiversity - Soil Science

- Soil Erosion Prevention- Chemical free Farming and Environmental Stewardship- Water Management and Ancient Indian Techniques - Water Storage and Groundwater Recharge- Drought-Prone Areas and Reviving Traditional Practices-Human and Animal Powered Devices-Biodiversity Support and Ecosystem Preservation-Modern Water Scarcity Solutions and Cultural Heritage in Water Management.

UNIT- IV AYURVEDA

9

Ayurveda and Holistic Health-Prakriti (Individual Constitution)- Personalized Health- Locally Sourced Remedies and Seasonal Foods- Sustainable Diet and Whole, Unprocessed Foods - Herbal Medicine and Natural Remedies - Yoga, Meditation, and Pranayama - Mental and Spiritual Well-Being- Resource Efficiency and Environmental Health- Non-Synthetic Healthcare and Home Remedies- Eco-Friendly Health Practices- Modern Healthcare Integration and Sustainable Wellness.

UNIT- V SPIRITUAL ECOLOGY

9

Moral Responsibility and Interconnectedness of Life- Cosmic Order and Ethical Living-
Environmental Ethics and Wildlife Conservation- Sustainable Resource Use-
Traditional Indian Festivals and Agricultural Cycle- Sustainability Movements and
Ethical Responsibility- Social Equity and Spiritual Well-Being- Intergenerational
Sustainability-Cultural and Environmental Preservation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Analyze the traditional learning methods, institutions, and disciplines such as Shastra, Kala, and Vidya.
2. Understand natural forces and energy efficiency in ancient Indian architecture. Explore the modern integration of Vastu principles for human well-being.
3. Understand traditional water management systems and their relevance to modern water conservation. Assess ancient Indian farming techniques and their ecological benefits
4. Understand the impact of Ayurvedic practices on environmental sustainability.
5. Understand the relationship between traditional Indian festivals and ecological balance.

TEXT BOOKS:

1. S. Narain "Education and Examination Systems in Ancient India" Kalpaz

Publications (2017).

2. Prof. Trilok Kumar Jain "Ancient Indian Science of Architecture: The Vastu Shastra" India - The Great Bharat (2025).
3. Geeta Vara "Ayurveda: Ancient Wisdom for Modern Wellbeing" Orion Spring (2018).
4. Llewellyn Vaughan-Lee "Spiritual Ecology: The Cry of the Earth" The Golden Sufi Center (2013)
5. R.S. Meena, "Sustainable Agriculture", Scientific Publishers (India) January 2019.

REFERENCE BOOKS:

1. S. P. Gupta "The Educational Heritage of Ancient India: How an Ecosystem of Learning Was Laid to Waste" Notion Press (2017).
2. Prof. (Dr.) B. B. Puri "Applied Vastu Shastra in Modern Architecture" Pratha Ayurveda (2022).
3. Dr. Ashish S. Jain , Dr. Bhushan R. Rane , Sunil R. Bakliwa "Integration of Ayurvedic Herbal Medicines Into Modern Medicinal Practices", Nirali Prakashan,2021.
4. P.S. Byadgi & A.K. Pandey "A Textbook of Kayacikitsa" (According to the Syllabus of CCIM, New Delhi); 3 Volumes Saujanya Books (2017).
5. Kalyan Kumar ,"Traditional Water Management Systems in India" Aryan Books International, 2007.

OAG103	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
CO2	1	-	-	-	-	-	-	-	1	-	-	2	-	-	-	-
CO3	-	-	-	3		1	2	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	1	-	-	3	-	-	-	-	-
CO5	-	-	-	-	-	1	1	3	2	-	-	2	-	-	-	-
Average	1.5	-	-	3	-	1	2	2	1.5	-	3	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. C.S. Rao “Environmental Pollution Control Engineering” 4th Edition (2022), New Age International Publishers.
2. S.C. Bhatia “Textbook of Noise Pollution and Its Control” Edition: 2023, Atlantic Publishers and Distributors.
3. Noel de Nevers, “Air Pollution Control Engineering” (Third Edition), Waveland press, Inc 2017.
4. Daniel Vallero, Fundamentals of Air Pollution, 2014, Fifth Edition, Elsevier’s Science & Technology, Academic Press, USA.
5. Enda Murphy, Eoin A. King, Environmental Noise Pollution: Noise Mapping, Public Health, and Policy, 2014, First Edition, Elsevier’s Science & Technology, USA.

REFERENCE BOOKS:

1. David H.F. Liu, Bela G. Liptak, "Air Pollution", Lweis Publishers, 2018.
2. Arthur C. Stern, "Air Pollution (Vol.I - Vol.VIII)", (Third Edition) Academic Press, 2013.
3. Wayne T. Davis, Joshua S. Fu, Thad Godish, Air Quality, 2021, Sixth Edition, CRC Press, USA.
4. Malcolm J. Crocker, Handbook of Noise and Vibration Control, 2007, John Willey and Sons Inc., USA
5. M.N Rao and HVN Rao, "Air Pollution", Tata Mcgraw Hill Publishing Company limited, 2007.

OCE101	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	-	1	-	-	1	1	2	-	-	-	-	-
CO2	-	-	2	3	-	-	3	2	2	-	-	3	-	-	-	-
CO3	1	2	3	-	-	2	2	3	-	2	-	-	-	-	-	-
CO4	-	2	-	3	-	-	-	-	2	2	-	2	-	-	-	-
CO5	1	1	2	3	-	1	3	3	1	1	2	3	-	-	-	-
Average	1.0	1.7	2.3	3.0		1.3	2.7	2.7	1.5	1.5	2.0	2.7	-	-	-	-

OCE102	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To develop a comprehensive understanding of sustainable development concepts, the EIA process, and stakeholders' roles.
- To acquire skills in EIA procedure, baseline monitoring, and impact assessment for land, water, air, noise, and energy.
- To evaluate policy and legal aspects, and formulate effective EMPs with mitigation strategies.
- Gain proficiency in environmental auditing and review of EIA reports for clearance.
- To analyze rehabilitation plans, and explore economic aspects, including valuation and ecological economics.

UNIT- I INTRODUCTION 9

Basic concepts - Impacts of Development on Environment – Rio Principles of Sustainable Development Environmental Impact Assessment (EIA) – Historical development – EIA in project cycle – EIA Notification and Legal Framework – Stakeholders and their Role in EIA.

UNIT- II EIA METHODOLOGIES 9

LCA - EIA Procedure - Baseline monitoring - Prediction and Assessment of Impact on land, water, air, noise and energy, flora and fauna – EIA Methods.

UNIT- III ENVIRONMENTAL MANAGEMENT PLAN 9

Policy and Legal Aspects of EMP - Environmental Policies and Programmes in India - Environmental Laws and Legislations - Environmental Monitoring Plan - Plan for mitigation of adverse impact on water, air and land, water, energy, flora and fauna.

UNIT- IV ENVIRONMENTAL AUDITING 9

Introduction to Environmental Auditing (EnA) - General Audit Methodology - Elements of Audit Process - Waste Audits and Pollution Prevention Assessments - Auditing of EMS – EIA Report Preparation – Review of EIA Reports - Environmental Clearance.

UNIT- V ENVIRONMENTAL MITIGATIONS AND ECONOMICS 9

Rehabilitation and Resettlement Plan - National Rehabilitation and Resettlement Policy

- Economics and the Environment - Environmental Valuation - Economics of Natural Resources - Ecological Economics.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand sustainable development, articulate EIA processes, and analyze stakeholder roles.
2. Proficient in EIA procedures, baseline monitoring, and impact assessment methodologies.
3. Evaluate policies, formulate effective EMPs, and integrate mitigation strategies.
4. Master environmental auditing, ensuring compliance and sustainability through critical reviews.
5. Analyze rehabilitation plans, integrate economic principles for sustainable decision-making.

TEXTBOOKS:

1. Rachna Bhateria, Mona Sharma, Rimmy Singh, Sumit Kumar, "Environmental Impact Assessment: A Journey to Sustainable Development", Springer Nature, 2024
2. V.S. Kulkarni, S.N. Kaul, R.K. Trivedy, "A Handbook of Environmental Impact Assessment", Scientific Publishers, 2024.
3. B.B. Hosetti, Arvind Kumar, "Environmental Impact Assessment and Management", Daya Publishing House, 2024.
4. Canter, R.L, "Environmental impact Assessment", 2nd Edition, McGraw Hill Inc, New Delhi, 1995.
5. 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.

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, 1999.

4. Ministry of Environment and Forests EIA Notification and Sectoral Guides, Government of India, New Delhi, 2010.
5. Peter Morris, Riki Therivel "Methods of Environmental Impact Assessment", Routledge Publishers, 2009.

OCE102	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	-	-	-	-
CO2	-	1	-	2	-	2	-	2	-	2	-	2	-	-	-	-
CO3	-	-	2	2	-	2	-	2	-	2	-	2	-	-	-	-
CO4	-	-	2	3	-	2	-	3	-	3	-	3	-	-	-	-
CO5	-	-	2	2	-	2	3	2	-	3	-	3	-	-	-	-
Average	1.0	1.5	2.0	2.3		2.0	3.0	2.2		2.6		2.4	-	-	-	-

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. Yudelso Jerry, "Green Building Through Integrated Design" McGraw-Hill Professional Publisher
2. Sustainable Building Design Manual. Vol 1 and 2, Teri, New Delhi, 2004.
3. "Low Energy Cooling For Sustainable Buildings". John Wiley and Sons Ltd, 2009.
4. K.S.Jagadish, B. U. Venkatarama Reddy and K. S. Nanjunda Rao.. "Alternative Building Materials and Technologies" New Age International, 2007.
5. "Green Building - Guidebook for sustainable Architecture", Dr. Michael Bauer, Peter mosle, Dr. Micheal Schwarz, Springer, 2007

REFERENCE BOOKS:

1. Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes (2nd Edition) by Sam Kubba, 2017.

2. Charles J. Kibert, "Sustainable Construction: Green Building Design and Delivery (5th Edition)" 2020.
3. Osman Attmann, Green Architecture Advanced Technologies and Materials, McGraw Hill, 2010.
4. Montoya Mike, "Green Building Fundamentals", Pearson Publication, 2011.
5. William E. Browning and William J. D. Looney, "Net Zero Energy Buildings: Perception, Design, and Performance" by Wiley (2015).

OCE103	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	-	-	-	-
CO2	1	2	-	2	1	2	-	-	-	2	-	2	-	-	-	-
CO3	1	2	2	2	1	2	-	-	-	2	-	2	-	-	-	-
CO4	1	2	2	3	2	2	-	-	-	3	-	3	-	-	-	-
CO5	1	2	2	2	3	2	3	-	-	3	-	3	-	-	-	-
Average	1.0	2.0	2.0	2.3	1.6	2.0	3.0			2.6		2.4	-	-	-	-

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:

- Gain knowledge on data science process.
- Perform data manipulation functions using Numpy and Pandas.

- Understand different types of machine learning approaches.
- Perform data visualization using tools.
- 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			
	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	-	-	-	-
Average	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.

TOTAL: 45 PERIODS

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			
	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	-	-	-	-	-	-	-	-	-	-	-
Average	2.0	-	1.6	-	1.0	-	-	-	-	-	-	-	-	-	-	-

COURSE OBJECTIVE:

- 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.

COURSE OUTCOMES:

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

- Understand the basics of IoT.
- Implement the state of the Architecture of an IoT
- Understand design methodology and hardware platforms involved in IoT.
- Understand how to analyze and organize the data.
- 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, 2018(unit 1,2,3,)
2. Internet of Things - A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015 (unit 5)
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education 2022(unit 4)

REFERENCE BOOKS:

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, Stamatias, 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 and CO - PSO MAPPING

OCS101	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	3	3	3	2				2			1	-	-	-	-
CO2	3	3	3	3									-	-	-	-
CO3	3	3	3		3		2	1		2			-	-	-	-
CO4	3	3	3	3	3						2		-	-	-	-
CO5	3	3	3	3	2	3	2			3	2	1	-	-	-	-
Average	3	3	3	3	2.5	3	2	1		2.5	2	1	-	-	-	-

COURSE OBJECTIVE:

- To understand the need for machine learning for various problem solving
- To study the various supervised, semi-supervised and unsupervised learning algorithms in machine learning
- To understand the latest trends in machine learning
- To design appropriate machine learning algorithms for problem solving

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

COURSE OUTCOMES:

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

- Understand the basic ideas and objective of machine learning
- Understand the problem of over fitting in machine learning.
- Transfer concrete problems to machine learning problems and select appropriate models to solve them.
- Understand how to analyze and organize the data using clustering methods.
- Understand reinforcement learning algorithms and experiment strategies.

TEXT BOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", The MIT Press, September 2020, ISBN 978-0-262-02818-9.(Units 1,3(Multilayer Perceptrons) & 4)
2. Mitchell, Tom, "Machine Learning", New York, McGraw-Hill, First Edition, 2017. (Units 2,5)

REFERENCE BOOKS:

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 and CO - PSO MAPPING

OCS102	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	-	1	1	-	1	-	-	1	-	-	-	-
CO2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	-	-
CO3	2	1	1	-	-	-	1	-	1	1	-	1	-	-	-	-
CO4	1	1	2	1	-	-	1	-	1	1	1	1	-	-	-	-
CO5	1	1	1	1	-	-	-	1	1	1	-	-	-	-	-	-
Average	1.2	1	1.3	1	1	1	1	1	1	1	1	1	-	-	-	-

COURSE OBJECTIVE:

- 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

COURSE OUTCOMES:

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

- Explain classification of Tamil grammar and properties
- Adopt a suitable process for tamil computing tools.
- Analyze the different types of computational linguistics such as phonology, Morphology, lexicography.
- Perform and analyze the Tamil computing applications.

- Analyze and process the Tamil python library.

TEXT BOOKS:

1. The Oxford Handbook of Computational Linguistics, Edited by RuslanMitkov, Oxford University Press, 2022.
2. Tamil Computing ,Dr.R.Ponnusamy, Allied Publishers private limited, 2024

REFERENCE BOOKS:

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 and CO - PSO MAPPING

OCS103	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	-	1	1	-	1	-	-	1	-	-	-	-
CO2	1	1	-	-	1	-	-	-	1	-	-	1	-	-	-	-
CO3	2	1	1	-	-	-	1	-	1	1	-	1	-	-	-	-
CO4	1	1	2	1	-	-	1	-	1	1	1	1	-	-	-	-
CO5	1	1	1	1	-	-	-	1	1	1	-	-	-	-	-	-
Average	1.2	1	1.3	1	1	1	1	1	1	1	1	1	-	-	-	-

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

9

UNIT – I : INTRODUCTION TO CYBER FORENSICS

Computer Forensics Fundamentals – Types of Computer Forensics Technology – Types of Computer Forensics Systems – Vendor and Computer Forensics Services.

UNIT – II : COMPUTER FORENSICS EVIDENCE AND CAPTURE

9

Data Recovery – Evidence Collection and Data Seizure-Duplication and Preservation of Digital Evidence-Computer Image Verification and Authentication.

UNIT – III : COMPUTER FORENSIC ANALYSIS

9

Discover of Electronic Evidence- Identification of Data – Reconstructing Past Events – Fighting against Macro Threats – Information Warfare Arsenal – Tactics of 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**COURSE 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. Marjie T. Britz, "Computer Forensics and Cyber Crime: Introduction to Digital Evidence," Pearson, 3rd Edition, 2021. (CHAPTERS 3 – 13). (UNIT IV – V)
2. John R. Vacca, "Computer Forensics: Computer Crime Scene Investigation", Cengage Learning, 2nd Edition, 2005. (CHAPTERS 1 – 18). (UNIT I – IV)

REFERENCE BOOKS

1. Mark L. Merkow, "Information Security: Principles and Practices," Pearson, 4th Edition, 2020.
2. MariE-Helen Maras, "Computer Forensics: Cybercriminals, Laws, and Evidence", Jones & Bartlett Learning; 2nd Edition, 2014.
3. Chad Steel, "Windows Forensics", Wiley, 1st Edition, 2006.
4. Majid Yar, "Cybercrime and Society", SAGE Publications Ltd, Hardcover, 2nd Edition, 2013.
5. Robert M Slade, "Software Forensics: Collecting Evidence from the Scene of a Digital Crime", Tata McGraw Hill, Paperback, 1st Edition, 2004.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	3	2														
CO 2		3		3												
CO 3	3		2			3										
CO 4	2		2													
CO 5	3			2		2										
Avg	2.8	2.5	2	2.5		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 1: 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 2: 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 3: THREATS AND ATTACKS**9**

Social Engineering-Cybercriminal Tactics-Suspicious Activity-Malware Links-Hacking Cases-Suspicious Content-Security Tests-Insider Threats-Threat Intelligence.

Unit 4: LEGAL AND ETHICAL ISSUES**9**

International Laws-Intellectual Property-Privacy Policies-Ethical Data Use-User Responsibilities-Legal Disputes- Freedom of Speech-Compliance Requirements-Regulation Future.

Unit 5: 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**COURSE OUTCOMES:**

- To Understand Social Media Platforms.
- To Identify Security Threats.
- To Protect Privacy and Apply best practices to protect personal information on social media.
- To Address Legal and Ethical Issues.
- To Apply Security Measures and Use tools and techniques to secure social media.

TEXT BOOK:

1. Michael J. K. Lee, "Social Media Security: Leveraging Social Networking to Defend Against Cyber Threats," Elsevier, 1st Edition, 2019.

2. "Social Media Security: Leveraging Social Networking While Mitigating Risk" by Michael Cross.
3. "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. Sanjay Purighalla, "Cybersecurity and Social Media," CRC Press, 1st Edition, 2021.
2. "Phishing Dark Waters: The Offensive and Defensive Sides of Malicious Emails" by Christopher Hadnagy and Michele Fincher.
3. The Ethical Hack: A Framework for Business Value Penetration Testing" by James S. Tiller.

CO – PO and PSO MAPPING:

Course Outcomes	Programme Outcomes (PO)												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO 1	1	2		3												
CO 2		1		2												
CO 3			1	2	3											
CO 4		1		2												
CO 5	1	1		2	2											
Avg	1	1.3	1	2.2	2.5											

OEC101	INTRODUCTION TO 5G COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the evolution of wireless networks.
- To learn the various features of 5G.
- To get acquainted with the fundamentals of EPC.
- To study the processes associated with 5G architecture.
- To explore the spectrum sharing and spectrum trading.
- To assess the security features in 5G networks.

UNIT-I: EVOLUTION OF WIRELESS NETWORKS 9

Networks evolution: 1G, 2G, 3G, 4G, Evolution of radio access networks, Need for 5G. 4G versus 5G, Next Generation Core (NG-Core), virtualized Evolved Packet Core (vEPC).

UNIT-II: 5G CONCEPTS AND CHALLENGES 9

Fundamentals of 5G technologies, Overview of 5G core network architecture, 5G new radio and cloud technologies, Radio Access Technologies (RATs), EPC for 5G.

UNIT-III: NETWORK ARCHITECTURE AND THE PROCESSES 9

5G architecture and core, Network slicing, Multi access edge computing (MEC) Visualization of 5G components, End-to-end system architecture, Service continuity, Relation to EPC, and Edge computing.

UNIT-IV: PROTOCOLS AND SPECTRUM MANAGEMENT 9

5G protocols: 5G NAS, NGAP, GTP-U, IP Sec and GRE, Mobility management, Command and control, Spectrum sharing and Spectrum trading, Cognitive radio based on 5G.

UNIT-V: SECURITY IN 5G NETWORKS 9

Security features in 5G networks, Network domain security, User domain security, Flow based QoS framework, Mitigating the threats in 5G.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Emphasize the basic theory of evolution of communication techniques
- Apply the concepts of 4G communication
- Assess the need for 5G communication Techniques
- Comprehend architecture and protocols for 5G communication
- Understand the principles of dynamic spectrum management
- Analyze the security aspects in 5G networks

TEXT BOOKS:

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.

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

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
OEC101.1	3	3	2	2	-	2	-	-	-	-	-	3	-	-
OEC101.2	3	3	3	2	-	2	-	-	-	-	-	2	-	-
OEC101.3	3	3	3	2	-	2	-	-	-	-	-	2	-	-
OEC101.4	3	3	3	2	-	2	-	-	-	-	-	2	-	-
OEC101.5	3	3	3	2	-	2	-	-	-	-	-	2	-	-
OEC101.6	3	2	3	2	-	2	-	-	-	-	-	2	-	-
AVG	3	2.8	2.8	2	-	2	-	-	-	-	-	2.2	-	-

OEC102	INTRODUCTION TO INDUSTRIAL IoT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand basic industrial processes and its reference architecture
- To perceive the knowledge of networks and programming of IIOT.
- To study the role of sensors, actuators and communication protocols used for interfacing.
- To introduce and familiarize the industry 4.0
- To master security in IIOT
- To study application of IIOT in various fields

UNIT-I: INTRODUCTION TO INDUSTRIAL IoT AND ITS ARCHITECTURE 9

IIoT Introduction, Industrial Internet Architecture Framework - Functional Viewpoint - Operational Domain, Information Domain, Application Domain, Business Domain - Implementation View point - Architectural Topology - Three Tier Topology - Data Management.

UNIT-II: NETWORKING AND PROGRAMMING OF IIoT 9

Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication. Industrial IoT- Layers: IIoT Communication, IIoT Networking. Industrial IoT: IIoT Analytics - Introduction, Machine Learning and Data Science, R and Julia Programming, Data Management with Hadoop.

UNIT-III: SENSOR AND INTERFACING 9

Introduction to sensors, Transducers, Classification, Roles of sensors in IIOT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IIOT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet, Current, and M2M.

UNIT-IV: COMPUTATION IN IIoT AND SECURITY 9

SDN in IIoT, Data Center Networks, Industrial IoT: Security and Fog Computing- Cloud Computing in IIoT, Industrial IoT Application Domains: Factories and Assembly Line, Food Industry.

UNIT-V: IIoT APPLICATIONS

9

Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security: AR and VR safety applications, Facility Management. Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Interpret basic industrial processes and its reference architecture
- Comprehend to the modern networking technologies and programming of IIOT.
- Illustrate the sensors, actuators and communication protocols used for interfacing.
- Analyze the concepts and gain insights into Industry 4.0
- Handle real time security issues in IIOT.
- Realize the importance of IIoT applications in real time.
- Create numerous IOT applications with the physical world of humans and real life problem solving.

TEXT BOOKS:

1. S. Misra, C. Roy, and A. Mukherjee, Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.2020
2. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things, Apress, 2017
3. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B.Rawart(Springer)
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.

REFERENCES:

1. Vijay 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
PEC504.1	1	-	1	-	-	-	-	-	-	-	-	3	-	-
PEC504.2	1	-	1	-	-	-	-	-	-	-	-	2	-	-
PEC504.3	2	3	3	3	-	-	-	-	-	-	-	2	-	-
PEC504.4	1	-	2	-	-	-	-	-	-	-	-	2	-	-
PEC504.5	2	1	3	2	-	-	-	-	-	-	-	2	-	-
PEC504.6	2	3	3	2	-	-	-	-	-	-	-	2	-	-
AVG	1.5	2.3	2.2	2.3	-	-	-	-	-	-	-	2.2	-	-

OEC103	ARDUINO PROGRAMMING AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the evolution of IoT boards
- To program Arduino to control lights, motors and other devices
- To learn Arduino's architecture, including inputs and connectors for add-on devices.
- To add third-party components such as LCDs, accelerometers, gyroscopes, and GPS trackers to extend Arduino's functionality.
- To explore various options in programming Arduino boards
- To test, debug, and deploy the Arduino to solve real world problems

UNIT-I: INTRODUCTION TO SENSORS 9

Transducers, Classification, Roles of sensors in IoT, Various types of sensors, Design of sensors, sensor architecture, special requirements for IOT sensors, Role of actuators, types of actuators.

UNIT-II: ARDUINO GPIOs and APIs 9

Hardware requirement for Arduino, Connecting remotely over the network using VNC, GPIO Basics, Controlling GPIO Outputs Using a Web Interface, APIs / Packages- Quark SOC processor.

UNIT-III: ARDUINO INTERFACES 9

Sensor with Arduino- Humidity, Proximity, IR Motion, Accelerometer, Sound, Light Distance, Pressure, Thermal - Reading various sensor data on serial monitor and LCD Display.

UNIT-IV: PROGRAMMING IN ARDUINO IoT DEVICE 9

Preparing the development environment (Arduino IDE), Exploring the Arduino language syntax, Coding, compiling, and uploading to the microcontroller, Working with Arduino Communication Modules: Bluetooth Modules, Wi-Fi Modules and I2C and SPI.

UNIT-V: PROGRAMMING ESP 8266 MODULE 9

ESP8266 Wi-Fi Serial Module: Overview, Setting Up the Hardware, Interfacing with Arduino, Creating an IoT Temperature and Humidity Sensor System, Overview of DHT-22 Sensor,

Interfacing the Hardware: Arduino, ESP8266 WiFi Module, and DHT-22 Sensor, Checking Your Data via Thing Speak.

TOTAL : 45 Periods

COURSE OUTCOMES:

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

- Understand the basics of sensors, its functioning.
- Execute basic and advanced assembly language programs.
- Learn the ways to interface I/O devices with processor for task sharing.
- Evoke the basics of co-processor and its ways to handle float values by its instruction set.
- Recognize the functionality of micro controller, latest version processors and its applications.
- Acquire design thinking capability, ability to design a component with realistic constraints, to solve real world engineering problems and analyse the results.

TEXT BOOKS:

5. Simon Monk, Hacking Electronics: Learning Electronics with Arduino and Raspberry Pi, 2nd Edition, McGraw-Hill Education, 2017.
6. Donald Norris, The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black, 1 st edition, McGraw Hill Education, 2015

REFERENCES:

1. Marco Schwartz, Home Automation with Arduino, 3rd edition, Open Home Automation 2014.
2. Schwartz, Marco. Internet of things with arduino cookbook, 1st edition, Packt Publishing Ltd, 2016.
3. Kooijman, Matthijs. Building Wireless Sensor Networks Using Arduino, 1st edition, Packt Publishing Ltd, 2015

COURSE OUTCOMES - PROGRAM OUTCOMES MATRIX

CO	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
OEC103.1	3	3	2	2	-	-	-	-	-	-	-	3	-	-
OEC103.2	3	3	3	2	-	-	-	-	-	-	-	2	-	-
OEC103.3	3	3	3	2	-	-	-	-	-	-	-	2	-	-
OEC103.4	3	3	3	2	-	-	-	-	-	-	-	2	-	-
OEC103.5	3	3	3	2	-	-	-	-	-	-	-	2	-	-
OEC103.6	3	2	3	2	-	-	-	-	-	-	-	2	-	-
AVG	3	2.8	2.8	2	-	-	-	-	-	-	-	2.2	-	-

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 WASTE 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.
3. 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	-	-	-	-	-	-	-
CO2	2	3	1	2	-	-	-	2	-	-	-	2	-	-
CO3	3	2	1	2	-	1	1	-	-	-	-	2	-	-
CO4	3	2	1	2	-	1	1	-	-	-	-	2	-	-
CO5	3	1	2	-	-	1	1	-	-	-	-	2	-	-
Average	2.6	2	1.3	2.3	-	1	1	2	-	-	-	2	-	-

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

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					-	-	-
CO2	2	3	1	2					1	1			-	-	-
CO3	2	3	2	3		3	2	1	2	1		1	-	-	-
CO4	2	1			1								-	-	-
CO5	2	1	3	1	3	2	2	1			2	2	-	-	-
AVG.	2.2	1.8	1.8	1.8	2	2.5	2	1	1.5	1	2	1.5	-	-	-

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.

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	-	-	-
CO2	2		2	2			1						-	-	-
CO3	2	2				1	1					1	-	-	-
CO4	3	3	3	3	1			3	1	2			-	-	-
CO5	2	1	2	1	1	1	1	2	1	1	1	1	-	-	-
AVG.	2.4	2	2.3	2	1	1	1	2.7	1	1.7	1	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:

- Understand and explain the fundamental concepts of multimedia and its components.
- Design and handle multimedia systems and files.
- Develop and manage hypermedia content and applications.
- Apply augmented reality techniques and integrate AR toolkits with various IDEs.
- 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. Billinghamurst, 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	-	-	-
2	1	-	2	-	3	3	-	-	-	3	3	1	-	-	-
3	3	2	2	-	2	1	1	1	1	1	1	1	-	-	-
4	3	3	3	-	2	1	1	1	1	1	1	1	-	-	-
5	3	3	3	-	3	1	1	1	1	1	1	1	-	-	-
Avg	2.6	2.4	2.4	-	2.2	1.4	1.0	1.0	1.0	1.6	1.8	1.0	-	-	-

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

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 Höter “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 Series In 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	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	3	2	-	-	-	-	-	2	-	-	-	-	-
5	-	-	2	3	2	-	-	-	-	-	-	-	-	-	-	-
Avg	2	2	2.3	2.7	2	-	-	-	-	-	2	2	-	-	-	-

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	-	-	-	-
2	2	3	3	2	3	-	-	-	2	3	2	2	-	-	-	-
3	2	3	3	3	3	-	-	-	2	2	2	2	-	-	-	-
4	2	2	3	2	3	-	-	-	2	2	1	2	-	-	-	-
5	2	3	3	3	3	-	-	-	2	3	3	2	-	-	-	-
Avg	2.2	2.6	2.8	2.4	3	-	-	-	2	2.4	1.8	2	-	-	-	-

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. Jones W.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	-	-
CO 2	2	1	1	1			2		1			1	-	-
CO 3	2	1	1	1			2		1			1	-	-
CO 4	2	1	1	1			2		1			1	-	-
CO 5	2	1	1	1			2		1			1	-	-
Average	2	1	1	1			2		1			1	-	-

(1 – LOW, 2-MEDIUM, 3-HIGH)

OME102	ADVANCED MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES:

The main learning objective of this course is:

1. To describe the concepts of various metal casting processes.
2. To demonstrate the concepts of various metal joining processes.
3. To describe unconventional machining processes
4. To demonstrate thermal and electrical based processes.
5. To describe the chemical and electrochemical-based process parameters, their influence on performance, and their application.

UNIT-I: METAL CASTING 9

Casting terminology, pattern material, allowance; Pattern types: Single piece, split, gated; Core prints, moulding sand properties, design of patterns, moulds and cores; solidification and cooling; riser and gating design. Melting furnaces: Blast and Cupola Furnaces; Principle of special casting processes: Shell - investment - Ceramic mould - Pressure die casting - Centrifugal Casting - Stir casting; Defects in Sand casting

UNIT-II: JOINING PROCESSES 9

Operating principle, basic equipment, merits and applications of fusion welding processes: Gas welding - Types - Flame characteristics; Manual metal arc welding - Gas Tungsten arc welding - Gas metal arc welding - Submerged arc welding - Electro slag welding; Operating principle and applications of resistance welding - Plasma arc welding - Thermit welding - Electron beam welding - Friction welding and Friction Stir Welding. brazing, soldering and adhesive bonding; Weld defects: types, causes and cure.

UNIT-III: MECHANICAL ENERGY BASED PROCESSES 9

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining – Ultrasonic Machining - (AJM, WJM, AWJM and USM) - Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT-IV: THERMAL AND ELECTRICAL ENERGY BASED PROCESSES 9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipment - Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits- Tool Wear –Dielectric – Flushing – Applications. Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM) – Working Principles – Equipment –Types – Beam control techniques – Applications.

UNIT-V: CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES 9

Chemical machining and Electro-Chemical machining (CHM and ECM) - Etchants – Maskant – techniques of applying maskants - Process Parameters – Surface finish and MRR- Applications. Principles of ECM- Equipment -Surface Roughness and MRR Electrical circuit -Process Parameters ECG and ECH – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Understand the various metal casting processes.
2. Understand the various metal joining techniques.
3. Describe the unconventional machining processes and the mechanical processes.
4. Understand the thermal and electrical-based processes.
5. Understand the chemical and electrochemical-based process parameters, their influence on performance, and their application.

TEXTBOOKS:

1. Serope Kalpakjian, Steven R.Schmid, “Manufacturing Engineering and Technology”, Pearson Education, Eighth Edition, 2020.
2. P.N. Rao, “Manufacturing Technology: Foundry, Forming and Welding – Volume 1”, Tata McGraw-Hill Publishing Limited, 2019.

REFERENCE BOOKS:

1. P.C. Sharma, “A text book of Production Technology (Manufacturing Processes)”, S. Chand and Company, 8th Edition 2014.
2. S.Gowri, P.Hariharan, and A.Suresh Babu, “Manufacturing Technology 1”, Pearson Education, 2020.

E- RESOURCES:

<https://archive.nptel.ac.in/courses/112/107/112107219>

<https://archive.nptel.ac.in/courses/112/105/112105212>

OME102	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2		1		1		1		1	1		1	-	-
CO2	2		1		1		1		1	1		1	-	-
CO3	2		1		1		1		1	1		1	-	-
CO4	2		1		1		1		1	1		1	-	-
CO5	2		1		1		1		1	1		1	-	-
Average	2		1		1		1		1	1		1	-	-

(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, carbo- nitriding, flame and induction hardening

UNIT-III: FERROUS ALLOYS 9

Classification, properties, microstructure, processing and applications of low, medium & high carbon steel & FG, SG, White, Malleable cast iron – effect of alloying elements on steel (Cr, Mo, V, Ti, Ni & W) - stainless steel and tool steels - HSLA steel & Maraging steels – Die steel, Wear of Metals - BIS Specification.

UNIT-IV: NON-FERROUS ALLOYS 9

Properties, Composition, Applications: Copper and its alloys - Brass, Bronze and Cupronickel – Aluminium and its alloys – Duralumin- Bearing alloys. Nickel and Titanium base alloys – Metals for low and high temperature applications- BIS Specification.

UNIT-V: MECHANICAL TESTING**9**

Mechanical properties - stress - strain curve for ferrous and non-ferrous alloys - Mechanism of plastic deformation, slip and twinning – Fracture: types – Griffith theory - Material testing: Tensile, compression and shear loads –Hardness tests: Brinell, Rockwell and Vickers - Impact test: Izod and Charpy - Fatigue and creep tests - fracture toughness tests - Characterization techniques: Optical, SEM, XRD.

TOTAL: 45 PERIODS**COURSE OUTCOMES:**

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

1. To recall the phase reactions of various metals and alloys.
2. To have great exposure in the heat treatment processes and know their purpose in engineering applications
3. To have knowledge in the classification, properties and applications of various ferrous alloys.
4. To classification and application of various nonferrous alloy materials.
5. To Identify the various mechanical properties for the ferrous and nonferrous alloys using modern testing facilities.

TEXTBOOKS:

1. Jindal. U.C “Material science and Metallurgy”, Pearson New Delhi, 2015.
2. Selvakumar N, “Engineering Metallurgy and Nanotechnology” Scitech, Publications (India) Pvt. Ltd., 2018

REFERENCE BOOKS:

1. Raghavan.V, “Materials Science and Engineering”, Prentice-Hall, 6th Edition, 2015.
2. William D Callister and David G. Rethwisch, “Material Science and Engineering: An Introduction”, John Wiley, 10th Edition, 2018.

E- RESOURCES:

<https://nptel.ac.in/courses/112108150> <https://www.digimat.in/nptel/courses/video/113107078/L01.html>

OME103	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	1	3	1								1	-	-
CO2	3	1	3	1								1	-	-
CO3	3	1	3	1								1	-	-
CO4	3	1	3	1								1	-	-
CO5	3	1	3	1								1	-	-
Average	3	1	3	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-l Waste management, Waste characteristics- Generation– Collection -

Material Composition-Transport– Treatment and disposal. Recycling and Recovery – intergraded e-waste management

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Gain the knowledge of the type, nature hazardous wastes.
2. Ability to plan minimization of hazardous wastes.
3. Ability to handle the bio medical Waste.
4. Ability to handle the radioactive waste.
5. Ability to handle the E- Waste Management.

TEXTBOOKS:

1. Hazardous waste management CharlesA.Wentz.Second edition 1995.McGraw Hill nternational.
2. Hazardous waste management Michael D. La Gerga, PhilipL Buckingham, Jeffrey C. Evans, Second edition 2010.Waveland Press.

REFERENCES:

1. Basic Hazardous waste management, “William C.Blackman.Jr”, Third Edition, 2001, Lewis Publishers
2. Integrated solid waste management George Techobanoglous, Hilary Theisen & Sammuel A.Vigil.

OME104	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	1				3		1			1	-	-
CO2	2	1	1				3		1			1	-	-
CO3	2	1	1				3		1			1	-	-
CO4	2	1	1				3		1			1	-	-
CO5	2	1	1				3		1			1	-	-
Average	2	1	1				3		1			1	-	-

(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. Jurgen, "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	-	-
CO2	3	2	1	1	1						1	1	-	-
CO3	3	2	1	1	1						1	1	-	-
CO4	3	2	1	1	1						1	1	-	-
CO5	3	2	1	1	1						1	1	-	-
Average	3	2	1	1	1						1	1	-	-

(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, "Nanotechnology: A Chemical Approach to Nanomaterials", RSC Publishing, 2nd Edition, United Kingdom, 2008.
3. Azamal Husen, Khwaja Salahuddin Siddiqi, "Advances in Smart Nanomaterials and their Applications (Micro and Nano Technologies)", 1st Edition, Elsevier, Netherlands, 2023.

REFERENCES

1. William A Goddard "Handbook of Nanoscience, Engineering and Technology", 3rd Edition, CRC Taylor and Francis, United Kingdom, 2012.
2. G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, London, 2004.
3. N. Kumar, "Concise concepts of nanoscience and nanomaterials", Scientific publishers, New Delhi, 2019.
4. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, Hyderabad, 2018.
5. Korada, Viswanatha Sharma, Hamid, Nor Hisham, Engineering Applications of Nanotechnology: From Energy to Drug Delivery, Springer, United States, 2017.

Course Outcomes	PROGRAM OUTCOMES												Program Specific Outcomes			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	2	-	-	-	-	-	-	-	-	1	-	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
CO4	2	1	1	1	-	1	-	1	-	-	-	1	-	-	-	-
CO5	2	1	1	1	1	1	-	1	-	-	-	1	-	-	-	-
AVG	2	1	1.3	1	1	1	-	1	-	-	-	1	-	-	-	-

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 biomineralization
- 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

OBJECTIVES:

1. To study the principles of management, functions and their application in an organization.
2. To educate the students on the concept of planning and decision-making.
3. To understand the dynamics of human relations in organisations.
4. To learn about motivation, communication and leadership aspects.
5. 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.

6**UNIT IV: DIRECTING**

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.
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						
Average	1	1.5	1		1			

OBJECTIVES:

1. To understand the Total Quality Management Concepts and Dimensions of Customers quality.
2. To familiarise the various contributions of Quality Gurus.
3. To understand the Framework of Quality Management.
4. To educate about tools and techniques in Quality Management.
5. 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).

Total Hours: 30**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 Management" 10th Edition, Cengage, Phillipine Edition, 2019.

2. Ray Tricker, Quality Management Systems: A Practical Guide to Standards Implementation, Routledge; 1st edition, 2019

3. Poornima M. Charantimath, Total Quality Management, Pearson Education, 2nd Edition, 2017.

4. Dale H. Besterfield, Carol Besterfield, Michna, Glen H. Besterfield, Mary Besterfield, Sacre, Hermant, Urdhwareshe, Rashmi Urdhwareshe, Total Quality Management, Revised 4th Edition, Pearson Education, 2013.

5. Shridhara Bhat K, Total Quality Management - Text and Cases, Himalaya Publishing House, 2nd Edition 2010.

6. Douglas C. Montgomery, Introduction to Statistical Quality Control, Wiley Student Edition, 7th 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				
Average	1	2		1				

OBJECTIVES:

1. To enable students to gain knowledge on Human resource management concepts and principles.
2. To familiarise students about HRP process and Job Analysis.
3. To illustrate the techniques and tools for Training and Development and Performance appraisal.
4. Students will be able to illustrate the techniques and tools for compensation.
5. 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				
Average		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: 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				
Average	1	2		1				

OBJECTIVES:

1. To provide awareness on how gender operates on Institutional and cultural context.
2. To understand about gender roles in society.
3. To understand the institutions of family and its influence on women's status.
4. To educate students on the gender issues.
5. 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, 6 th edition, 2014
2. Rege, Sharmila (ed), Sociology of Gender: The Challenge of Feminist Sociological
3. Knowledge, Sage, New Delhi, 2003.
4. Bonnie G. Smith, 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	
Average				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 /Soliloquy**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

- Seasons of Life: A Poetic Anthology (Literary Classics) by Nigel Collins, Jim Herrick, John Pearce (ISBN: 9781573927710)
Web Link : <https://www.amazon.co.uk/Seasons-Life-Anthology-Literary-Classics/dp/1573927716>
- New One-Act Plays for Acting Students: A New Anthology of Complete One-Act Plays for One, Two or Three Actors Paperback – by Norman Bert (Author), Deb Bert (Editor)
Web Link : <https://www.amazon.in/New-One-Act-Plays-Acting-Students/dp/1566080843>
- Student Text (Drama Essentials: An Anthology of Plays) Paperback – by Matthew C. Roudane (Editor)
Web Link : <https://www.amazon.in/Drama-Essentials-Student-Anthology-Plays/dp/0618474773>
- Famous Novels and Short stories in English.(to be recommended by teachers to individual students)
- 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:

1. To recognize the importance of IP and to educate the pupils on basic concepts of Intellectual Property Rights.
2. To identify the significance of practice and procedure of Patents.
3. To make the students to understand the statutory provisions of different forms of IPRs in simple forms.
4. To learn the procedure of obtaining Patents, Copyrights, Trade Marks & Industrial Design
5. 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 secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigations.

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. Sople, Vinod V. Managing Intellectual Property: The Strategic Imperative, PHI, 2020

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

OBJECTIVES:

1. To understand the core concepts, history, and significance of Industrial Psychology
2. To analyze factors influencing employee attitudes, behaviors, and well-being.
3. To apply principles of ergonomics and human factors to improve workplace design and safety.
4. To evaluate different theories of motivation and their practical applications in organizational settings.
5. To assess team dynamics, cultural diversity, and organizational change processes in modern workplaces.

UNIT I: FOUNDATIONS OF INDUSTRIAL PSYCHOLOGY AND JOB ANALYSIS**9**

Definition, Characteristics, Goals, and Importance of Industrial Psychology - Brief History of Industrial Psychology - Major Fields in Industrial Psychology - Research Methods in Industrial Psychology - Job Analysis: Methods and Techniques - Performance Measurement: Concepts and Practices - Performance Rating and Evaluation - The Social Context of Performance Evaluation

UNIT II: EMPLOYEE ATTITUDES, BEHAVIOUR, AND WELL-BEING**9**

Work Attitudes and Employee Engagement - Job Satisfaction and Organizational Commitment - Positive Employee Behaviors - Worker Stress: Sources, Consequences, and Coping Strategies

UNIT III: ERGONOMICS AND ENGINEERING PSYCHOLOGY**9**

Principles of Ergonomics and Human Factors - Work Design for Productivity and Well-being - Psychological Aspects of Workplace Safety - Human-Technology Interaction.

UNIT IV: MOTIVATION IN THE WORKPLACE**9**

Defining and Theories of Motivation - Need-Based Theories of Motivation (e.g., Maslow's Hierarchy of Needs, Alderfer's ERG Theory) - Behaviour-Based Theories of Motivation (e.g., Skinner's Reinforcement Theory) - Job Design Theories of Motivation (e.g., Hackman and Oldham's Job Characteristics Model) - Motivation and Performance - Practical Techniques to Enhance Motivation

UNIT V: GROUP DYNAMICS AND ORGANIZATIONAL CULTURE**9**

Defining Work Groups and Teams - Types of Teams and Team Processes - Group Decision- Making and Effectiveness - Diversity and Multiculturalism in Teams - Organizational Culture and Development

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
Average	2	3	2	2	1	1	1	1.5

MBA104	INDIAN CONSTITUTION	L	T	P	C
		3	0	0	0

OBJECTIVES:

1. To create an awareness on the constitution of India and its amendments.
2. To educate the students with fundamental duties and rights of the citizens.
3. To equip with the functions of central government and its' structure.
4. To learn the state government structure and its' functions.
5. To understand the judiciary structure and its functions in India.

UNIT I: INTRODUCTION 09

Introduction to constitution of India – Philosophical Foundations and Historical Background – Preamble – Schedule – 42nd Amendment - 44th Amendment – 73rd Amendment - 74th Amendment – Articles Related to Amendments.

UNIT II: FUNDAMENTAL DUTIES AND RIGHTS OF CITIZENS 09

Citizenship – Citizenship Amendment Act (CAA) – Union of States - Union Territories - Fundamental Rights – Directive Principles of State Policy (DPSP) – Fundamental Duties - Reference of Articles for Granting of Special Status to Various States in the Country.

UNIT III: CENTRAL GOVERNMENT STRUCTURE AND FUNCTIONS 09

Government at Central Level – President of India – Powers of President of India – Structure of Central Government – Functions of Central Government – Vice President – Powers of Vice President – Powers of Prime Minister – Powers of Cabinet Ministers – Powers of Parliament.

UNIT IV: STATE GOVERNMENT STRUCTURE AND FUNCTIONOONS 09

Government at State Level – Structure of State Government – Functions of State Government – Governor – Powers of Governor – Chief Minister – Powers of Chief Minister – State Legislature – Powers of Cabinet Ministers in State Legislature – Cabinet Ministers Responsibilities in State Government.

UNIT V: JUDICIARY STRUCTURE AND FUNCTIONS 09

Supreme Court of India – Judiciary System in Indian Constitution – Judicial Systems Central Government Level – Judiciary System in State Government Level – High Courts and Subordinate Courts – Election Commission of India – Case Studies of Major Disputes.

TOTAL HOURS: 45

OUTCOMES:

1. Students will be able to understand the constitution of India and its' amendments.
2. Students will be able to analyze the fundamental duties and rights of citizens.
3. Students will be able to narrate the central government structure and its functions.
4. Students will be able to discuss the state government structure and its functions.
5. Students will be able to derive judiciary structure and its functions.

REFERENCES:

1. Basu, D. D. (1966). Introduction to the Constitution of India. LexisNexis, India.
2. Khosla, Madhav (2012). The Indian Constitution. Oxford University Press, India.
3. R.C.Agarwal (1997). Indian Political System. SChand Company Ltd., India.
4. Bakshi, P. (2023). The Constitution of India. LexisNexis, India.
5. V. N. Shukla (2017). Constitution of India, 13th Ed., Eastern Book Company.

PO-CO Mapping	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	2			1				1
CO2	2		3	2	3	3	1	1
CO3	2	3	2	1		1		
CO4	2		2	1		1		
CO5	2		2	1	2	1	1	
Avg.	2	3	2.3	1.2	2.5	1.5	1	1

MGE201 WELL BEING WITH TRADITIONAL PRACTICES
- YOGA, AYURVEDA AND SIDDHA

COURSE OBJECTIVES:

1. To enjoy life happily with fun filled new style activities that help to maintain health
2. To adopt a few lifestyle changes that will prevent many health disorders
3. To be cool and handbill every emotion very smoothly in every walk of life
4. To learn to eat cost-effective but healthy foods that are rich in essential nutrients
5. To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE

2+4

Health: Definition - Importance of maintaining health - More importance on prevention than treatment - Ten types of health one has to maintain - Physical health - Mental health - Social health – Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health – Environmental health. Occupational/Professional health. Present health status - The life expectancy- present status - mortality rate - dreadful diseases - Non- communicable diseases (NCDs) the leading cause of death - 60% - heart disease – cancer – diabetes - chronic pulmonary diseases - risk factors – tobacco – alcohol - unhealthy diet - lack of physical activities. Types of diseases and disorders - Lifestyle disorders – Obesity – Diabetes – Cardiovascular diseases – Cancer – Strokes – COPD - Arthritis - Mental health issues. Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time. Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) – Maintaining BMI-Importance and actions to be taken.

UNIT II DIET

4+6

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 - Panchcheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (TriDosha Theory) - Udal Thathukkal.

Prevention of illness with our traditional system of medicine.

Primary Prevention - To decrease the number of new cases of a disorder or illness – Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention – To decrease the amount of disability associated with an existing disorder.

UNIT IV MENTAL WELLNESS

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

TEXT BOOKS:

1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

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.
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.

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/>
2. Simple lifestyle modifications to maintain health <https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-betterhealth#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.>
3. Read more: <https://www.legit.ng/1163909-classes-food-examples-functions.html>
4. <https://www.yaclass.in/p/science-state-board/class-9/nutrition-and-health-5926>
5. Benefits of healthy eating <https://www.cdc.gov/nutrition/resources-publications/benefitsof-healthy-eating.html>
6. Food additives
<https://www.betterhealth.vic.gov.au/health/conditionsandtreatments/foodadditives>
7. BMI <https://www.hsph.harvard.edu/nutritionsource/healthy-weight/>
<https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---whorecommendations>
8. Yoga <https://www.healthifyme.com/blog/types-of-yoga/>
<https://yogamedicine.com/guide-types-yoga-styles/>
Ayurveda : <https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda>
9. Siddha : http://www.tkdl.res.in/tkdl/langdefault/Siddha/Sid_Siddha_Concepts.asp
10. CAM : <https://www.hindawi.com/journals/ecam/2013/376327/>
11. Preventive herbs : <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/>

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

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 maktabas, madrasas and karkhanas set up. Developments in the fields of Mathematics, Chemistry, Astronomy and Medicine. Innovations in the field of agriculture - new crops introduced new techniques of irrigation etc

UNIT III SCIENCE AND TECHNOLOGY IN COLONIAL INDIA**9**

Early European Scientists in Colonial India- Surveyors, Botanists, Doctors, under the Company's Service- Indian Response to new Scientific Knowledge, Science and Technology in Modern India- Development of research organizations like CSIR and DRDO; Establishment of Atomic Energy Commission; Launching of the space satellites.

UNIT IV IMPACT OF SCIENCE AND TECHNOLOGY IN MAJOR AREAS**9**

Space – Objectives of space programs, Geostationary Satellite Services – INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology Ocean Development – Objectives of ocean development, Biological and mineral resources, Marine research and capacity building.

Defence Research – Spin-off technologies for civilian use, Biotechnology – Applications of biotechnology in medicine, Biocatalysts, Agriculture, Food, Fuel and Fodder, Development of biosensors and animal husbandry Energy – Research and development in conservation of energy, India's nuclear energy program, technology spin-offs.

UNIT V NEXUS BETWEEN TECHNOLOGY TRANSFER AND DEVELOPMENT

9

Transfer of Technology – Types, Methods, Mechanisms, Process, Channels and Techniques, Appropriate technology- Criteria and selection of Appropriate technology: Technology assessment, Technological forecasting, Technological innovations and barriers of technological change. Social implications of new technologies like the Information Technology and Biotechnology

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Kalpana Rajaram, Science and Technology in India, Published and Distributed by Spectrum Books (P) Ltd., New Delhi – 58.
2. Srinivasan, M., Management of Science and Technology (Problems & Prospects), East-West Press (P) Ltd., New Delhi.

REFERENCE:

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

Course Objectives

- To understand the basics of cyber security and cyber law,
- To understand the problems and issues associated with it,
- To understand the various act or regulations,
- To understand the various approaches for incident analysis and response.
- To understand the ethical laws of computer for different countries.

UNIT I INTRODUCTION TO CYBER SECURITY AND CYBER CRIME 9

Introduction-Cyber Crime: Definition and origins- Cybercrime and information Security- Cyber criminals- Classification of Cybercrimes.

UNIT II LEGAL PERSPECTIVES 9

Introduction to the Legal Perspectives of Cybercrimes and Cyber security, Cybercrime and the legal Landscape around the World, Why Do We Need Cyber laws, The Indian IT Act, Challenges to Indian Law and Cybercrime Scenario in India.

UNIT III CYBER ACT 9

Consequences of Not Addressing the Weakness in Information Technology Act, Digital Signatures and the Indian IT Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario.

UNIT IV CYBER LIABILITY 9

Private ordering solutions, Regulation and Jurisdiction for global Cyber security, Copy Right-source of risks, Pirates, Internet Infringement, Fair Use, postings, criminal liability, First Amendments, Data Losing.

UNIT V CYBER CHANGES 9

Ethics, Legal Developments, Cyber security in Society, Security in cyber laws case studies, General law and Cyber Law-a Swift Analysis.

TOTAL: 45 PERIODS

Course Outcomes

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

CO1 – Understand key terms and concepts in cyber security and cyber law, intellectual Property and cyber- crimes, trademarks and domain theft.

CO2 – Determine computer technologies, digital evidence collection.

CO3 – Determine evidentiary reporting in 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. Sunit Belapure and Nina Godbole, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India Pvt. Ltd, 2011.
2. Jonathan Rosenoer, "Cyber Law: The law of the Internet", Springer-Verla..

Reference Books

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

CO S	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO 1	PO2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
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	-	-	-	-

OBJECTIVES:

1. To discuss the basic approaches of the organizations and safety management
2. To discuss the concept of Work design and facility planning
3. To comprehend the accident investigation process and accident reports
4. To discuss the principles of safety performance monitoring
5. To elaborate the methods of safety education and training

UNIT I BASICS OF SAFETY ENGINEERING & ACTS 9

Evolution of modern safety concept – Safety audit – Acts: Factories act – 1948 – Statutory authorities – Tamil Nadu factories Rules 1950 under safety and health – Environment act – 1986 – Air act 1981, Water act 1974 – other acts; Safety in industries – General safety concepts, machine guarding, hazards in metal removing process, welding process, cold and hot working process. Introduction to Electrical Acts.

UNIT II SAFETY MANAGEMENT 9

History of Safety movement – Evolution of modern safety concept General concepts of management – Planning for safety for optimization of productivity, quality and safety line and staff functions for safety, budgeting for safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety.

UNIT III ACCIDENT INVESTIGATION AND REPORTING 9

Concept of an accident, reportable and non-reportable accidents, unsafe act and condition – Principles of accident prevention, Supervisory role - Role of safety committee – Accident causation models Cost of accident. Overall accident investigation process Response to accidents, India reporting requirement, Planning document, Planning matrix, Investigators Kit, Functions of investigator, Four types of evidences, Records of accidents, Accident reports Class exercise with case study.

UNIT IV SAFETY PERFORMANCE MONITORING 9

Reactive and proactive monitoring techniques, Permanent total disabilities, Permanent partial disabilities, Temporary total disabilities - Calculation of accident indices, Frequency rate, Severity rate, Frequency severity incidence, Incident rate, Accident rate, Safety “t” score, Safety

activity rate problems.

UNIT V SAFETY EDUCATION AND TRAINING

9

Importance of training identification of training needs training methods – programme, seminars, conferences, competitions – method of promoting safe practice motivation – communication role of government agencies and private consulting agencies in safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign – Domestic Safety and Training.

TOTAL: 45 PERIODS

OUTCOMES:

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

1. Learn the basic approaches of the organizations and safety management
2. Perform work design and facility planning
3. Study the accident investigation process and accident reports
4. Learn the principles of safety performance monitoring
5. Study the methods of safety education and training

TEXTBOOKS:

1. L M Deshmukh, Industrial safety management, TATA McGraw Hill, 2017.
2. Heinrich H.W., Industrial Accident Prevention, McGraw Hill Company, New York, 2001.

REFERENCES:

1. Garg, HP, Maintenance Engineering, S. Chand Publishing, 2012
2. J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.

MME204	PROGRAM OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3		1			2			1			2		
CO2		1		2				2			1			
CO3	2			2			1			2		2		
CO4	2		3			2			2		1			
CO5		2			2			1				1		
Average	2.3	1.5	2	2	2	2	1	1.5	1.5	2	1	1.7		

**COURSES IN MINOR DEGREE
OFFERED BY DEPARTMENT OF MANAGEMENT STUDIES (DMS)
FOR B.E / B.TECH (HONOURS) / OPTIONAL COURSES (R2023)**

VERTICAL 1: FINTECH AND BLOCKCHAIN

BAM101

FINANCIAL MANAGEMENT

**L T P C
3 0 0 3**

COURSE OBJECTIVES

1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance.
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy.
5. To develop an understanding of tools on Working Capital Management.

UNIT I INTRODUCTION TO FINANCIAL MANGEMENT 9

Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of Money-Risk and return concepts.

UNIT II SOURCES OF FINANCE 9

Long term sources of Finance-Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits etc.

UNIT III INVESTMENT DECISIONS 9

Investment Decisions: Capital budgeting – Need and Importance –Techniques of Capital Budgeting - Payback - ARR – NPV – IRR – Profitability Index. Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock - Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV FINANCING AND DIVIDEND DECISION 9

Capital Structure – determinants of Capital structure- Designing an Optimum capital structure. Dividend policy - Aspects of dividend policy - practical consideration - forms of dividend policy - Determinants of Dividend Policy.

UNIT V WORKING CAPITAL DECISION 9

Working Capital Management: Working Capital Management - concepts - importance -Determinants of Working capital - Working capital operating cycle. Cash Management: Motives for holding cash –

Objectives and Strategies of Cash Management. Receivables Management: Objectives - Credit policies.

TOTAL: 45 PERIODS

RSE 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:

- To understand Blockchain's fundamental components, and examine decentralization using blockchain.
- To explain how cryptocurrency works, from when a transaction is created to when it is considered part of the Blockchain.
- To explain the components of Ethereum and Programming Languages for Ethereum.
- To study the basics of Hyperledger and Web3.
- To know about alternative Blockchains and Blockchain projects in different domains.

UNIT I INTRODUCTION TO BLOCKCHAIN 9

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.

UNIT II INTRODUCTION TO CRYPTOCURRENCY 9

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin limitations – Name coin – Prime coin – Zcash – Smart Contracts – Ricardian Contracts.

UNIT III ETHEREUM 9

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

UNIT IV WEB3 AND HYPERLEDGER 9

Introduction to Web3 – Contract Deployment – POST Requests – Development Frameworks – Hyperledger as a Protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT V ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS 9

Kadena – Ripple – Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous Tools.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Understand the technology components of Blockchain and how it works behind the scenes.
2. Understand Bitcoin and its limitations by comparing with other alternative coins.
3. Devise solution using the Ethereum model.
4. Understand and use Hyperledger and its development framework.
5. Track alternative Blockchains and emerging trends in Blockchain.

TEXTBOOK:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands On Approach”, VPT, 2017.
2. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly, 2014.
3. Roger Wattenhofer, “The Science of the Blockchain” CreateSpace Independent Publishing, 2016.
4. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.
5. Alex Leverington, “Ethereum Programming” Packt Publishing, 2017.

CSM101	PROGRAM OUTCOMES												PSO's			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	3	-	-	1	-	-	3	-	-	1	-	-	-	-	-	-
CO2	-	3	3	-	-	-	-	3	3	-	-	-	-	-	-	-
CO3	-	-	3	1	-	-	-	-	3	1	-	-	-	-	-	-
CO4	3	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	3	-	-	-	-	-	3	-	-	-	-	-
CON	3	3	3	1	3	-	3	3	3	1	3	-	-	-	-	-

COURSE OBJECTIVES

1. To introduce the foundational concepts of Financial Technology (FinTech) and its applications in personal finance, inclusive finance, and digital financial services.
2. To familiarize students with digital payment systems and cryptocurrencies, including their underlying technologies, security concerns, and legal frameworks.
3. To provide insights into InsurTech innovations, focusing on the integration of AI, ML, and IoT in risk management, underwriting, and fraud detection in insurance.
4. To enable understanding of peer-to-peer lending models and crowdfunding ecosystems, with a focus on digital infrastructure and financing solutions for SMEs and MSMEs.
5. To develop awareness of global and domestic FinTech regulations, and the emergence of RegTech as a tool for ensuring regulatory compliance and fraud monitoring using AI.

UNIT I INTRODUCTION TO FINTECH AND DIGITAL FINANCE 9

Overview of FinTech: Definition, scope, applications. History of Financial Innovation and Digitization. Alternative Finance: Crowdfunding – Types (Charity, Equity), platforms. Introduction to Initial Coin Offering (ICO). Role of FinTech in personal finance and inclusive finance.

UNIT II DIGITAL PAYMENTS AND CRYPTOCURRENCIES 9

Introduction to Cryptocurrencies: Bitcoin and Applications. Types of Cryptocurrencies and Digital Wallets. Basics of Blockchain Technology. National Payment Systems: Real-Time Gross Settlement (RTGS), Immediate Payment Service (IMPS), Unified Payments Interface (UPI). Digital Payments: Smart Cards, Mobile Payments, Payment Gateways, Virtual Currencies. Legal, Security, Privacy, and Ethical Issues in Digital Transactions.

UNIT III INSURTECH AND DIGITAL INSURANCE INNOVATIONS 9

Introduction to InsurTech. Role of (Artificial Intelligence (AI), Machine Language (ML), and Internet of Things (IoT) in insurance services. Risk Modelling, Fraud Detection. Innovations in Claims Processing and Underwriting. Impact on traditional insurance business models.

UNIT IV P2P LENDING AND FINANCIAL INCLUSION 9

Peer-to-Peer (P2P) and Marketplace Lending. Architecture and Technology Platforms. Crowdfunding Unicorns and Business Models. Financing for SME/MSME – Opportunities, Challenges, and FinTech Solutions.

UNIT V FINTECH REGULATIONS AND REGTECH

9

Global and Indian FinTech Regulations. Legal and Regulatory Risks. RegTech: Definition, Evolution. RegTech Ecosystem – Institutions, Startups, Regulators. Role of AI in Compliance and Fraud Monitoring.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to explain the fundamentals of cryptocurrencies, digital wallets, blockchain and payment systems such as UPI, RTGS, and IMPS, along with related security and regulatory aspects.
2. Students will describe the evolution of digital finance and analyze alternative finance models like crowdfunding and Initial Coin Offerings (ICO).
3. Students will evaluate the role of AI, ML, and IoT in InsurTech applications such as underwriting, claims processing, risk modeling, and fraud detection.
4. Students will analyze P2P lending and crowdfunding platforms, infrastructure, and innovations for SME/MSME financing.
5. Students will interpret FinTech regulations and assess the role of RegTech and AI in ensuring compliance and detecting fraud.

REFERENCES

1. Swanson, Seth Fintech for Beginners: Understanding and Utilizing the Power of Technology. Create Space Independent Publishing Platform 2016.
2. Tanda, Alessandra & Schena, Cristiana-Maria FinTech, BigTech and Banks: Digitalisation and Its Impact on Banking Business Models. Springer 2019.
3. Diedrich, Henning Ethereum : Blockchains, Digital Assets, Smart Contracts, Decentralized Autonomous Organizations. Wildfire Publishing 2016.
4. William, Jacob Fin Tech: The Beginner's Guide to Financial Technology. Create Space Independent Publishing Platform 2016.
5. Indian Institute of Banking and Finance (IIBF) Digital Banking. Taxmann Publications 2016.

COURSE OBJECTIVES

1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION 9

Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY 9

FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY 9

FinTech in Wealth Management Industry-Financial Advice, Automated investing, Socially responsible investing, Fractional Investing, Social Investing. FinTech in Insurance Industry- P2P insurance, On-Demand Insurance, On-Demand Consultation, Customer engagement through Quote to sell, policy servicing, Claims Management, Investment linked health insurance.

UNIT IV FINTECH AROUND THE GLOBE 9

FinTech developments - US, Europe and UK, Germany, Sweden, France, China, India, Africa, Australia, New Zealand, Brazil and Middle East, Regulatory and Policy Assessment for Growth of FinTech. FinTech as disruptors, Financial institutions collaborating with FinTech companies, The new financial world.

UNIT V FUTURE OF FINTECH 9

How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks

partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL: 45 PERIODS

COURSE OUTCOMES

1. Students can able to understand and describe the historical phases of FinTech.
2. Students can able to recognize how FinTech is revolutionizing payments, lending, wealth tech, insurance, and emerging sectors across different regions.
3. Students can able to understand the nuances of fintech in wealth management industry.
4. Students can able to compare major FinTech hubs and understand strategic collaborations between traditional financial institutions and tech firms.
5. Students will understand the future of fintech.

REFERENCES

1. Arner D., Barbers J., Buckley R, The evolution of FinTech: a new post crisis paradigm, University of New South Wales Research Series, 2015
2. Susanne Chishti, Janos Barberis, The FINTECH Book: The Financial Technology Handbook for Investors, Entrepreneurs and Visionaries, Wiley Publications, 2016
3. Richard Hayen, FinTech: The Impact and Influence of Financial Technology on Banking and the Finance Industry, 2016
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
5. Sanjay Phadke, Fintech Future : The Digital DNA of Finance Paperback .Sage Publications, 2020

VERTICAL 2: ENTREPRENEURSHIP

BAM201

FOUNDATIONS OF 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 – 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

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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. Coggburn 2015.
4. Public Administration: An Introduction, 12th Ed, by David H. Rosenbloom, Robert S. Kravchuk, Richard M. Clerkin 2019.
5. Public Personnel Management, 4th Ed, by Donald E. Klingner, John Nalbandian 2018

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. Indian 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

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.

MINOR DEGREE VERTICAL - 5

AGM501	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To impart knowledge about sustainable Infrastructure development goals.
- To practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.
- To understand how infrastructure projects are conceptualised and planned and the project lifecycle phases
- To learn concepts related to infrastructure economics and finance, including various project feasibility models
- To understand and assess the use of various risk management processes and practices in the context of infrastructure projects

UNIT- I **SUSTAINABLE DEVELOPMENT GOALS** **9**

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian – Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands – Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian - Infrastructure Project finance - Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

UNIT- II **SUSTAINABLE INFRASTRUCTURE PLANNING** **9**

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition -Legal aspects, Resettlement & Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure

Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning – Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

UNIT- III SUSTAINABLE CONSTRUCTION PRACTICES AND 9 **TECHNIQUES**

Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction — Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice - Design considerations, Design Parameters and Procedures - Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT- IV SUSTAINABLE CONSTRUCTION MATERIALS 9

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption - Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility - Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies -Design for Disassembly - Dematerialization, rematerialization, transmaterialization — Green procurement and green distribution - Analysis framework for reuse and recycling - Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations — Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC — Case studies.

**UNIT- V SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE
PROJECTS**

9

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions. — Use of Emerging Technologies — IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. Understand the environment sustainability goals at global and Indian scenario.
2. Understand risks in development of projects and suggest mitigation measures.
3. Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.
4. Explain Life Cycle Analysis and life cycle cost of construction materials.
5. Explain the new technologies for maintenance of infrastructure projects.

TEXTBOOKS:

1. Charles J Kibert, Sustainable Construction : Green Building Design & Delivery, 4th Edition , Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell,UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers, 2011.
4. William P Spence, Construction Materials, Methods & Techniques (3e), Yesdee Publication Pvt. Ltd, 2016.
5. New Building Materials and Construction World magazine

REFERENCE BOOKS:

1. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher: Belhaven Press.
2. Munier N, "Introduction to Sustainability", Springer 2005.
3. Sharma, "Sustainable Smart Cities In India: Challenges And Future Perspectives", SPRINGER, 2022.
4. Ralph Horne, Tim Grant, Karli Verghese, Life Cycle Assessment: Principles, Practice and Prospects, Csiro Publishing, 2009
5. European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. Luxembourg. European Union; 2010

AGM501	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	1	1	-	2	3	1	1	-	2	1	-	-	-	-
CO2	3	1	3	2	1	2	2	-	1	1	1	2	-	-	-	-
CO3	2	2	3	1	1	1	1	-	-	-	1	1	-	-	-	-
CO4	3	1	3	2	2	1	3	1	1	1	1	2	-	-	-	-
CO5	3	1	2	2	2	2	3	1	-	1	1	2	-	-	-	-
Average	2.6	1.3	2.4	1.6	1.5	1.6	2.4	1	1	1	1.2	1.6	-	-	-	-

AGM502	SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT	L	T	P	C
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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	-	-	-	-	-	-
CO2	-	2	-	2	2	2	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	2		2	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	2	-	-	2	2	2	2	-	-	-	-	-
CO5	-	2	3	2	-	-	1	-	-	-	-	1	-	-	-	-
Average	3	2	3	2	2	2	1	2	2	2	2	1	-	-	-	-

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 BIOCOSCOMPOSITES 9

General properties- Bio ceramics -Silicate glass - Alumina (Al_2O_3) -Zirconia (ZrO_2)- 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	NANOBIO MATERIALS	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	1.5	1.8	1	-	-	-	-	-	-	-	-	-	-

OBJECTIVES:

- To familiarize the students about the challenges and demands of energy sustainability.
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell.
- To enable students to appreciate novel materials and their usage in photovoltaic application.
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT- I SUSTAINABLE ENERGY SOURCES 9

Introduction to energy demand and challenges ahead - sustainable source of energy (wind, solar etc.) - electrochemical energy systems for energy harvesting and storage - materials for sustainable electrochemical systems building - India centric solutions based on locally available materials - Economics of wind and solar power generators vs. conventional coal plants - Nuclear energy.

UNIT- II ELECTROCHEMICAL DEVICES 9

Electrochemical Energy - Difference between primary and secondary batteries - Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O₂ battery, Nickel Cadmium, Nickel Metal Hydride) - Primary battery (Alkaline battery, Zinc-Carbon battery) - Materials for battery (Anode materials - Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials - S, LiCoO₂, LiFePO₄, LiMn₂O₄) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based).

UNIT- III FUEL CELLS 9

Principle of operation of fuel cells - types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) - Thermodynamics of fuel cell – Fuel utilization – electrolyte membrane (proton

conducting and anion conducting) - Catalysts (Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) - Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

UNIT- IV PHOTOVOLTAICS

9

Physics of the solar cell - Theoretical limits of photovoltaic conversion - bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells - thin film silicon solar cells - multijunction solar cells - amorphous silicon based solar cells - photovoltaic concentrators - Cu(InGa)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, Pushpendra Singh, Materials Today: Proceedings, 2022.
4. Raphael, B. (2022). Construction and Building Automation: From Concepts to Implementation. Routledge.
5. Sinopoli, J. M. (2009). Smart buildings systems for architects, owners and builders. Butterworth-Heinemann.

AGM504	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	-	-	-	-	-	3	-	-	-	-	-	2	-	-	-
CO2	1	-	-	-	-	-	-	-	1	-	-	2	-	3	1	-
CO3	-	-	-	3		1	2	-	-	-	-	-	-	2	-	2
CO4	-	-	-	-	-	-	-	1	-	-	3	-	1	-	2	-
CO5	-	-	-	-	-	1	1	3	2	-	-	2	-	-	-	-
Average	1.5	-	-	3	-	1	2	2	1.5	-	3	2	1.5	2.5	1.5	2

OBJECTIVES:

- To acquire knowledge on green systems and the environment, energy technology and efficiency, and sustainability.
- To understand the principles of green chemistry and eco friendly methodologies.
- To create awareness on Cleaner development mechanisms.
- To develop concepts on various energy efficient systems and green buildings.
- To provide green engineering solutions to energy demand, reduced energy

UNIT- I	PRINCIPLES OF GREEN CHEMISTRY	9

Introduction to green chemistry and technology. Twelve principles of green chemistry. Green technology-definition, importance, factors affecting green technology. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.

UNIT- II POLLUTION TYPES 9

Pollution — types, causes, effects, and abatement. Waste — sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

UNIT- III GREEN REAGENTS AND GREEN SYNTHESIS 9

Cleaner development technologies Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labelling. Oxidation technology for waste water treatment- Cavitation, Fenton chemistry, photocatalysis and hybrid processes.

UNIT- IV DESIGNING GREEN PROCESSES 9

Energy efficient systems and processes Energy efficient motors, energy efficient lighting, control and selection of luminaries; bio-fuels, fuel cells- working, selection of

fuels, Green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of sustainable green production systems.

UNIT- V GREEN NANOTECHNOLOGY

9

Green Buildings Definition- Features and benefits, Fundamental planning decisions for energy efficient building- site selection, buildings forms and orientations, building fabrics and insulation, ventilation, passive solar features. Ecofriendly and cost effective materials, Energy management, roof top solar photovoltaic system and solar tracking system, alternating roofing systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able

1. To understand the principles of green engineering and technology.
2. To learn about pollution using hazardous chemicals and solvents
3. To modify processes and products to make them green and safe.
4. To design processes and products using green technology.
5. To understand advanced technology in green synthesis.

TEXTBOOKS:

1. Soli J. Arceivala, "GREEN TECHNOLOGIES", McGraw Hill Education, 2017.
2. Khan B.H, Non conventional energy resources, Tata McGraw-Hill, New Delhi 2006.
3. Green Chemistry - An introductory text - M. Lancaster, RSC, 2016.
4. Rashmi Sanghi and M.M. Srivastava, Green Chemistry-Environment Friendly Alternatives, Narosa Publishing House, New Delhi 2009.
5. Paul L. Bishop, Pollution prevention-Fundamentals and Practices, McGraw-Hill- international 2000.

REFERENCE BOOKS:

1. Ritu Dogra, "Renewable Energy and Green Technology", Brillion Publishing, 2023.
2. Green chemistry metrics - Alexi Lapkin and david Constable (Eds) ,Wiley publications,2008
3. Environmental chemistry, Stanley E Manahan, Taylor and Francis, 2017
4. Green technology and design for the environment, Samir B. Billatos, Nadia A. Basaly, Taylor & Francis, Washington, DC, ©1997
5. Sambit Kumar Mishra, Zdzislaw Polkowski, Samarjeet Borah, Ritesh Dash, "AI in Manufacturing and Green Technology: Methods and Applications" CRC Press, 2021.

AGM505	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	1	-	-	-	1	2	-	-	-	3	-	2	1	1	2	-
CO2	1	2	-	2	1	2	-	-	-	2	-	2	1	-	2	-
CO3	1	2	2	2	1	2	-	-	-	2	-	2	2	-	2	-
CO4	1	2	2	3	2	2	-	-	-	3	-	3	1	1	2	1
CO5	1	2	2	2	3	2	3	-	-	3	-	3	1	1	2	-
Average	1.0	2.0	2.0	2.3	1.6	2.0	3.0			2.6		2.4	1.2	1	2	1

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) & 9
RISK ASSESSMENT

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.

AGM506	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	-	-	-	-
CO2	-	1	-	2	-	2	-	2	-	2	-	2	-	-	-	-
CO3	-	-	2	2	-	2	-	2	-	2	-	2	-	-	-	-
CO4	-	-	2	3	-	2	-	3	-	3	-	3	-	-	-	-
CO5	-	-	2	2	-	2	3	2	-	3	-	3	-	-	-	-
Average	1.0	1.5	2.0	2.3		2.0	3.0	2.2		2.6		2.4	-	-	-	-